RAILROAD GAZETTE

SATURDAY, JULY 1, 1871.

THE ILLINOIS & ST. LOUIS BRIDGE.

Report of the Chief Engineer, October 1, 1870.

We have delayed publishing the following interesting report of Capt. James B. Eads in order to present it with engravings of the structure, copies of the lithographs accompanying the report, for which we are indebted to *Engineering*:

ST LOUIS, Oct. 1, 1870.

To the President and Directors of the Illinois & St. Louis Bridge Company:

GENTLEMEN: I have the honor to submit the following report:

THE WEST ABUTMENT.

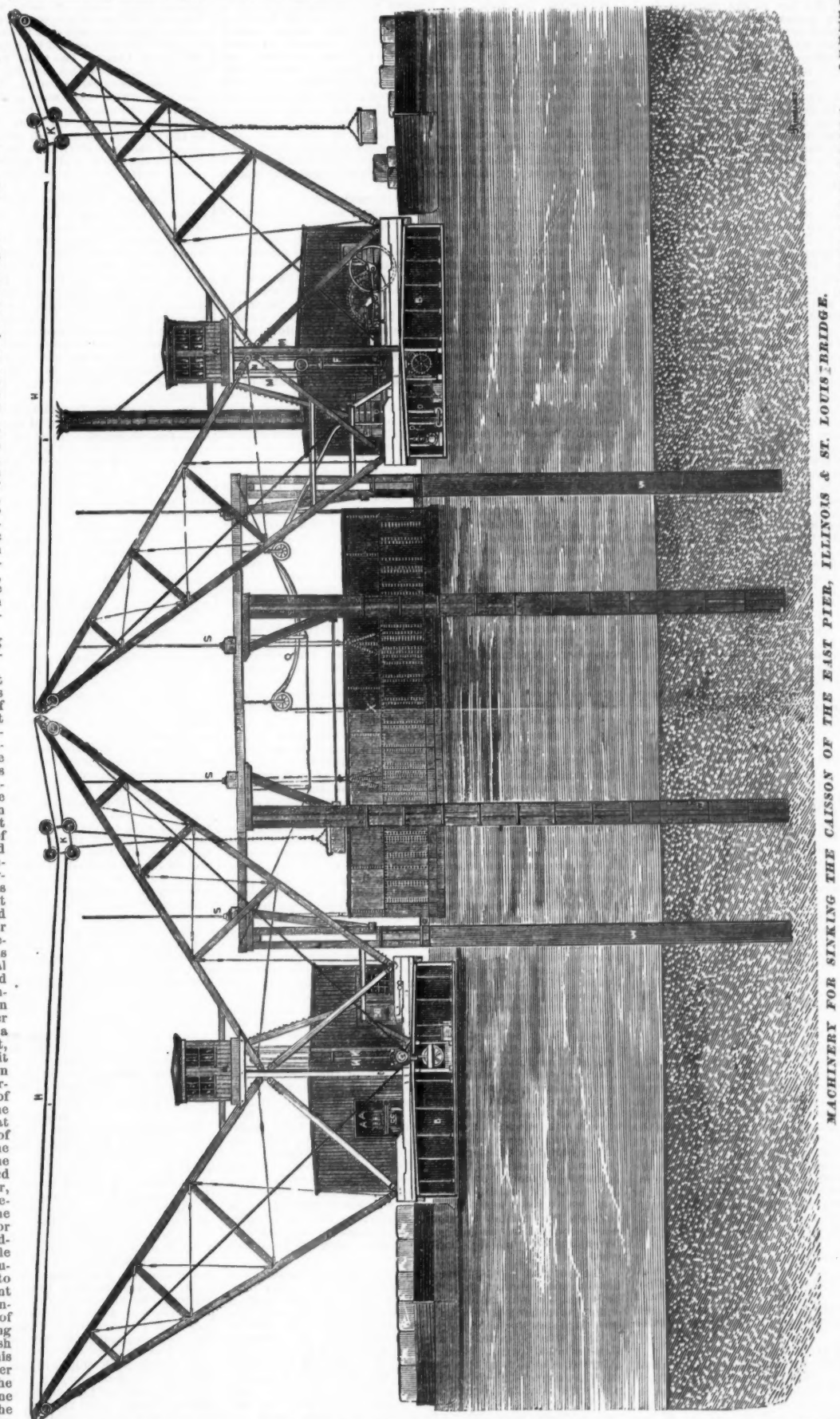
The masonry of the west abutment has been completed from the bed-rock of the river to a point thirty-one feet above low-water mark. From the bed-rock to the top of the masonry the height is now forty-four feet. Eight courses of granite are laid on it and two courses, or five feet, are required to complete it to the skewbacks against which the steel ribs of the western span will rest. This mass of solid masonry stands upon the lower edge of the wharf in St. Louis, and measures at its base, in the direction of the river current, ninety-four feet, and transversely sixty-two feet nine inches, and contains at this time 6,380 cubic yards of masonry. When completed to the carriage-way, it will be 115 feet high, above the bed-rock of the river, and will then contain 11,860 cubic yards of masonry.

The work on it is going steadily forward in a satisfactory manner.

Although the bed-rock at the site of this abutment is seventy-three and a half feet higher than at the east pier, the difficulties encountered in building its foundation were of a much more perplexing and tedious character than those encountered at either of the others. Its site had been for over sixty years a part of the steamboat wharf of the city, and as such had received every kind of useless material thrown overboard from the various steamers lying over it during that time. The old sheet-iron enveloping their furnaces, worn-out grate-bars, old fire-bricks, parts of smoke-stacks, stone-coal cinders and clinker, and every manner of things entering into the construction of a Mississippi steamer seemed to have found a resting place at this spot, and constituted a deposit averaging twelve feet in depth over the rock. During the memorable fire of 1849, when twenty-nine steamers were destroyed at the levee, the wrecks of two of them sunk upon the site of this abutment. One of these was partly covered by the hull of the other, which probably sunk immediately afterwards. The lower one was but two or three feet above the bed-rock. After this terrible conflagration, the city authorities determined to widen the wharf. Its front was extended to a line inclosing about one-half of these two wrecks, by filling in with stone and rubbish from the city. During this extension, several other vessels were burnt at the wharf, and the wreck of one of these also sunk upon the site of the abutment. The coffer-dam constructed to enclose the site had to be put down through these three wrecks, the hulk of either of which was not probably less than four hundred tons measurement. Their bottom planking was all of oak, three or four inches in thickness. To drive the sheet piling down through these hulks, an oak beam six by ten inches square, armed with a huge steel chisel, was first driven down as far as a steam pile-driver could force it. It was then withdrawn and a sheet-pile, five by ten inches square, was driven down in its place. The coffer-dam was formed of two courses of sheet-piling, six feet apart, which were filled in between with clay. When this was completed, the water pumped out and the excavation prosecuted within it, the discovery was made that from one-third to one-half of the length of each of these three steamboat hulks was enclosed within the dam, and that some of the sheet-piling had not been driven through the lower one, owing to the great resistance of the hulk and the mass above it. Before the space between the lower wreck and the bed-rock could be made secure on the inner side of the dam, the water came through and flooded the inclosure. A stream from a powerful Gwynne pump, having an eight-inch diameter of jet, was then directed against the material deposited over these wrecks on the outer side of the dam, where the water was fifteen feet deep, and enough of the deposit was washed away to enable another course of sheet-piling to be driven down six feet beyond the dam, through all the wrecks to the rock. After this, that part of the wrecks enclosed between this last course of piling and the dam was removed by a diver and the space filled with clay, and the inclosure again pumped out. This portion of the dam, about fifty feet in length, was by this construction, made double. As the excavation within progressed, it revealed the fact that another portion of the dam had been built and made water-tight through and over a water wheel of one of the wrecks. The crank of an engine of seven feet stroke attached to the head of the shaft of the wheel was just within the inclosure, while the flanges, arms and braces of the wheel were within the walls formed by the sheet-piling. From the inclosure within the dam were taken parts of several old and burnt steamboat engines, the iron parts of some of which had to be cut off at the dam. Four wrecks of barges, some of them in use doubtless before the era of steam, were also found within it; likewise several oak sawlogs, some anchors, chains and a great variety of smaller articles lost or thrown overboard from the river craft, or dumped in from the city.

This incongruous deposit made it exceedingly difficult to maintain the integrity of the dam, which at times had to resist a pressure of thirty feet of water. Frequent floodings consequently occurred, which delayed and increased the cost of the work. These difficulties were, however, finally overcome, and the bed-rock within was at last exposed to view.

On the 25th day of February, 1868, after thoroughly testing the solidity of the rock by drilling, the first stone of your bridge was laid in this abutment fifty-five feet below high-water mark, about four months after commencing the construction of the dam.



MACHINERY FOR SINKING THE CAISSON OF THE EAST PIER, ILLINOIS & ST. LOUIS BRIDGE.

THE EAST PIER.

The caisson for sinking the east pier described in my published report, September 1, 1869, having been completed, and the requisite guide piles, air and sand pumps, hoisting machinery, etc., being made ready, it was launched from the ways at Carondelet, on the 18th of October, 1869, and was towed up to its position in the river and duly secured within the guide piles on the same day. Some days more were occupied in securing the caisson to the suspension screws that were to steady it until it reached the sandy bed of the river, and in connecting the various air and water-pipes with it. On the 25th day of October, the first stone was laid upon it, from which moment until it reached the bed-rock of the river, on the 28th of February last (one hundred and twenty-eight feet below high-water mark, or one hundred and twenty feet below the city directrix), the progress of its descent and the working of the machinery connected with it, were marked by an almost total freedom from accident.*

During low water the normal depth of sand over the bed-rock at this pier is about eighty feet. A rise in the river causes it to scour down, whilst a subsidence of the flood permits the moving sands from above to deposit rapidly and again raise the sand bed. At the time of placing the caisson in position the water in the river was thirty-five feet deep, and sixty-eight feet of sand were then overlying the rock. As the caisson descended, the current sweeping under its bottom at the rate of about three and a half miles per hour, caused a further scour of five feet, leaving an irregular surface of sand, averaging about sixty-three feet deep above the rock. When the caisson had fairly entered the sand a deposit was made rapidly around it, especially in the eddy created below the caisson. The sides of the caisson were swept to some extent by the current, otherwise the derrick boats on each side of it would have grounded on the deposit. This deposit was increased by the discharge from the sand pumps and by the completion of the ice-breaker above the pier, so that, for twenty or thirty days before it reached the rock, the sand was visible above the water, both above and below the caisson. The iron walls of the caisson had consequently a severe external pressure upon them from this mass of sand, and as the sides of the pier were inclined whilst the walls of the caisson were vertical, a space was left between the two. This space was at first occupied with bracings against the masonry to sustain the walls. As the pier descended and the pressure increased, sand from the pumps was discharged into it and in this way the walls were relieved; the height of sand inside, between the caisson walls and the pier, being maintained at the level of the sand on the outside. The design was to keep the masonry constantly built up above water, as the pier descended. The failure of the granite company to deliver in time the granite which was intended to form the exterior of the pier above low-water mark, prevented me from following out this design. At the time the granite was wanted, the river was from ten to twelve feet above low-water mark, and there was left only the alterna-

* An inspection of the plates will give the reader a clearer idea of the method and appliances used in sinking the east and west piers.

tive of stopping the descent of the caisson that much above the bed-rock and awaiting the receipt of the granite, or else allowing the pier to descend and trust to the walls of the caisson to exclude the water above the top of the pier. Three courses of granite, each two feet thick, were received in time, but when the pier reached the bed-rock the top of the masonry was about six feet below the surface of the water.

To prevent danger to the workmen in the air-chamber, in the event of the walls of the caisson giving way under a pressure of water and condition of things deemed possible, but not expected, the shafts or wells through the masonry, by which access was obtained to the air-locks which were at the bottom of the pier, were kept securely built up above the level of the water. On one or two occasions leaks occurred in the caisson walls, causing the top of the masonry to be flooded. But this precaution prevented a suspension of the work of filling the air-chamber under the pier with concrete, in consequence of such accidents, as the shafts remained free from water. During the month of April, however, the river rose to within nine feet six inches of the city directrix, and was nineteen feet six inches above the top of the masonry. From the moment the caisson touched the rock up to this time, the filling of the air-chamber with concrete had been progressing almost without interruption. When the water reached this point, the walls of the caisson suddenly sprung a leak, and the pier was again flooded in a few moments. As the flooding of the pier usually increased the leakage in the shafts very much, it was not found practicable to continue work in the air-chamber when it happened, if the depth over the pier exceeded a few feet. When this accident occurred, the men were immediately signalled to come up from the air-chamber, then 110½ feet below the surface of the river. This they did with entire safety. A suspension of work on the pier was then ordered until the water should subside.

Examinations of the caisson walls were made by our diver, Captain Quigley, and careful soundings were made to ascertain the depth of the sand on the inside and outside of the caisson. It was then discovered that fifty-five feet in depth of the sand on the east side of the caisson (on the outer side) had been scoured away by the action of the current, the soundings showing but thirty-five feet of sand remaining above the bed-rock. This had reversed the strains on the caisson walls; the corresponding fifty-five feet of sand on the inside between the pier and the caisson, had by its gravity burst out the eastern wall of the caisson, now no longer supported by the sand on the outside. This wall was of plate iron ⅜ of an inch in thickness. This rupture rendered the further use of the caisson as a coffer dam forever after impracticable. The upper portion of it was consequently removed, and in its stead there was secured around the pier a wooden dam, joined together in sections corresponding to the sides and ends of the pier, and having a large cushion near its lower edge, on the inner side, to fit against the fourth joint of the masonry below the top course of the pier. This work was admirably executed under the direction of the Superintendent of Construction, Mr. W. K. McComas; the submarine work being very skilfully performed by Captain Quigley. On the 13th of August the water was again pumped off from the top of the masonry. Since this time the pier has been carried up to the height of 117 feet above the bed-rock on which it rests, and is now (October 1) nineteen feet nine inches above the present level of the river-surface. The coffer-dam has been removed from around it, and no apprehension of further trouble from water during its completion need be entertained. It measures at its base, in the direction of the current, eighty-two feet in length, and transversely sixty feet, and on the top at its present height, seventy-five feet seven inches by thirty-five feet one inch. It now contains 13,240 cubic yards of masonry, concrete and brick work. The vertical wells or shafts through it, were lined with brick work from thirteen to twenty-two inches in thickness. These openings were carefully filled up with concrete and the entire pier is now one solid mass of masonry.

In addition to the almost constant presence of the Superintendent of Construction, in charge of all the works, it was made the duty of three civil engineers, familiar with the plans, machinery, etc., to give their personal superintendence to the sinking of the pier; one being constantly on duty, watching the progress of the work, and keeping a record of everything of interest occurring. The necessary number of steam engineers, machinists and firemen, were employed for keeping the engines at work night and day, and the machinery in perfect order, so that the work could go on with ut any interruption whatever. To accomplish this desirable object, sufficient duplicate pumps, engines, boilers, etc., were provided, so that the failure of any one piece of the machinery would cause no stoppage in the progress of the work. The pier was placed on the rock in 126 days after the laying of the first stone, which period included the most inhospitable season of the year. The mason work was suspended during twenty days of this time on account of bad weather. During fifteen days it was impossible to tow a barge of stone to the pier on account of the running ice.

TELEGRAPH.

When this pier had reached the depth of sixty-six feet, a telegraphic instrument was placed in the air chamber and a wire was led to the office of the Superintendent of Construction on one of the derrick boats at the pier, and also to the office of the Chief Engineer in this city. By this means messages were transmitted to and from the air-chamber, and between the offices of the Superintendent of Construction and that of the Chief Engineer, by which I was, when not present, regularly advised of the progress and condition of the work during the sinking of the pier. The knowledge that a means of communication with the upper world was constantly at hand in the air-chamber, and one which was not likely to be interrupted by any accident endangering the lives of the workmen in it, was productive of a very salutary moral effect upon them.

These telegraphic arrangements were courteously put up complete under the gratuitous superintendence of Col. Chas. H. Haskins, General Superintendent of the Pacific & Atlantic Telegraph Company. The instruments were of the kind known as "alphabetical," and were easily understood and operated by those placed in charge of them in the service of the Bridge Company.

FILLING THE AIR-CHAMBER.

The filling of the air-chamber was executed in the most careful and substantial manner under the immediate direction of the Superintendent of Construction. The preparation and disposition of the concrete were made in the air-chamber (from 103 to 110½ feet beneath the surface of the river), under the immediate supervision of Mr. Rudolph Wieser, C. E., Chief Inspector of Masonry, and his assistants, Mr. Richard Richardson and Mr. Fritz Eberley, master masons, one or the other being constantly on duty. From frequent personal inspection, I am warranted in saying that this part of the work is unsurpassed in excellence by that of any part of the masonry above water.

The filling of the air-chamber with concrete commenced on the second day of last March, and was finished on the 27th of last May. The working time being fifty-three days. The space filled may be fairly stated at nearly 36,000 cubic feet. The area of the base of the pier is 4,020 square feet and the height of the chamber nine feet. The caisson was stopped as soon as it touched the bed-rock. This was at its southwest corner. At the northwest corner its edge was eight inches from the rock. The northeast corner was sixteen inches and the southeast corner eight inches. It will be seen from this, that the rock was, fortunately, very nearly level. The sand beneath the edge of the caisson was removed, the rock laid bare and the space filled carefully with concrete, the air pressure being sufficient to prevent a more rapid infiltration of the water under the edge of the caisson than could be managed by the pumping arrangements within it. The sand seemed packed so firmly that no trouble was taken to barricade it out of this space between the rock and the edge of the caisson. When the entire edge of the caisson and the space under its two great girders were thus concreted, the rock in its interior was gradually cleared of sand and the concrete placed directly upon it in layers of nine or ten inches in thickness, the closing courses under the roof of the chamber being stoutly rammed in place. The air-locks were then filled with the same material, and finally the shafts. The concrete was made of broken limestone thoroughly washed, the interstices being filled with mortar made of equal parts of Akron cement and pure sand.

During the sinking of the pier the sand pumps designed by me for this special purpose, gave great satisfaction and proved entirely successful. One pump of three and one-half inches bore was found quite capable of raising twenty cubic yards of sand 120 feet high per hour; the water pressure required to supply the jet being about 150 pounds per square inch.

PRESSURE IN THE AIR-CHAMBER.

The pressure of air in the air-chamber was very accurately determined by the depth of the caisson below the surface. Any greater pressure than that due to the depth caused the air to escape beneath it; but when the caisson had penetrated into the sand to a considerable distance, it was discovered that the water level formed by the air under or across the bottom of the chamber was nearly a foot lower than the bottom edge of the caisson. When the caisson was but a few feet in the sand, the air forced its way up by its sides in one or two currents of large volume; but as it penetrated more deeply, the passage of air through the sand evidently became more difficult, and it appeared in small bubbles sixty or seventy feet distant from the caisson. This retardation of the escapement of the air from beneath the caisson caused an increase of air pressure by which the water was held at a greater or lesser depth below the line of the bottom of the air-chamber. The sand inclosed in the air-chamber and forming its floor was usually one or two feet more elevated than the lower edge of the chamber, and was entirely devoid of water, the air pressure expelling the water from it down below the edge of the caisson as just stated. The distance to which it was thus expelled and maintained was at no time discovered to exceed ten inches, and generally it was not over eight inches. This would give an air pressure equal to nearly one foot more than the depth of the caisson, or about one-third of a pound per square inch more. This difficulty of escapement of the air through the sand was increased somewhat by concreting under the edge of the caisson on the rock, and the actual air pressure could then be no longer actually determined by the height of the water above. The pressure gauges usually indicated a pressure of one or two pounds more than the depth of water would give by calculation. This was caused, in a great measure, however, by the friction of the air in the pipes, the gauges being at the pumps and not in the air-chamber. A column of water 110½ feet in height would be equal to a pressure of 47.96 pounds per square inch, assuming the weight of water to be 62.5 pounds per cubic foot. The greatest pressure marked by the gauges was fifty-two pounds, and it is not probable that the pressure in the air-chamber ever exceeded fifty or fifty-one pounds.

EFFECTS OF COMPRESSED AIR ON THE MEN.

The first symptom manifesting itself, caused by the pressure of the air, is painfulness in one or both ears. The Eustachian tubes, extending from the back of the mouth to the bony cavities over which the drums of the ears are distended, are so minute as not to allow the compressed air to pass rapidly through them to these cavities, and when the pressure is increased rapidly, the external pressure on the drums causes pain. These tubes constitute a provision of nature to relieve the ears of such barometric changes as occur in the atmosphere in which we live. The act of swallowing facilitates the passage of air through them, and thus equalizes the pressure on both sides of the drums, and prevents the pain. The pressure may be admitted into the air-lock so rapidly that this natural remedy will not, in all cases, relieve it. By closing the nostrils between the thumb and fingers, shutting the lips tightly and inflating the cheeks, the Eustachian tubes are opened and the pressure on the inner and outer surfaces of the tympanum is equalized, and the pain prevented. This method must be used and repeated from time to time as the pressure is let on, if it be increased rapidly. No inconvenience is felt by the reaction when the pressure is let off, as the compressed air within the drums has a tendency to open the tubes, and thus facilitates its escape through them; whereas increasing the pressure has the effect of collapsing them, and therefore makes it more difficult to admit the compressed air within the cavities of the ears. It frequently occurs, however, from some abnormal condition of these tubes, as when inflamed by a cold in the head, that neither of these remedies will relieve the pain. To continue the admission of compressed air into the lock, under such circumstances, would intensify the suffering, and possibly rupture the tympanum, therefore the lock-tenders were particularly instructed to shut off the compressed air at the moment any one in the lock experienced pain about the ears; and then, if it could not be relieved by the above means, the lock was opened and the person was not permitted to go through into the air-chamber. Sometimes fifteen minutes were occupied in passing persons through the first time, after which they usually had no further trouble from this cause.

The fact that the depth penetrated by the air-chamber was considerably greater than that hitherto reached in any similar work, left me without any benefit from the experience of others, in either guarding against any injurious effects of this great pressure upon the workmen and engineers subjected to it, or of availing myself of any known specific for relieving those affected by it. When the depth of sixty feet had been attained, some few of the workmen were affected by a muscular paralysis of the lower limbs. This was rarely accompanied with pain, and usually passed off in the course of a day or two. As the penetration of the pier progressed, the paralysis became more difficult to subdue. In some cases the arms were involved, and in a few cases the sphincter muscles and bowels. The patients also suffered much pain in the joints when the symptoms were severe. An average of at least nine out of ten of those affected suffered no pain whatever, but soon recovered, and generally returned to the work.

The duration of the watches in the air-chamber was gradually shortened from four hours to three, and then to two, and finally to one hour.

The use of galvanic bands or armor seemed, in the opinion of the Superintendent of Construction, the foremen of the chamber, and the men, to give remarkable immunity from these attacks. They were all ultimately provided with them. These bands were made of alternate scales of zinc and silver, and were worn around the wrists, arms, ankles and waist, and also under the soles of the feet. Sufficient moisture and acidity were supplied by the perspiration to establish galvanic action in the armor, and as the opinion among those most accustomed to the chamber was almost unanimous in favor of this remedy, I am very much inclined to believe it valuable.

Immediately on the manifestation of greater severity in the symptoms, a hospital-boat was fitted up at the pier, and one of the ablest physicians in the city (Dr. A. Jaminet) was engaged to attend those affected, and also to institute such sanitary measures as his judgment should dictate. A careful examination of the health and bodily condition of every workman was daily made, and none were permitted to engage in the work without the approval of Dr. Jaminet. Those most severely affected were sent to the City Hospital, and had the benefit of the advice and treatment of its resident physician, Prof. E. A. Clark. The total number of men employed in the air-chamber of this pier was 352. Of this number about thirty were seriously affected. Notwithstanding the care and skill with which those most severely attacked were treated, twelve of the cases proved fatal. Each one of these, without exception, I believe, was made the subject of careful inquest by the coroner, aided by an autopsy conducted usually by some of the most skillful surgeons and physicians. Whilst the exciting cause in all of these cases was doubtless the exposure of the system to the pressure of the condensed air of the chamber, the habits and condition of several of those who died were, at the time they went to work, such as would have excluded them from it if subjected to the examination of Dr. Jaminet, and the verdict in about one-half of the cases gave a totally different cause for the death of the patient. Nearly or quite all of these deaths happened to men unaccustomed to the work; several of them to men who had worked but one watch of two hours. In contrast to this is the fact that quite a large number of the men (certainly one-half of those constantly employed) commenced with the work at its inception, and remained throughout its continuance, entirely without injury or inconvenience.

The gentlemen composing the engineer corps of the bridge all visited the air-chamber, some of them quite often, either in the discharge of their professional duties, or from motives of curiosity, and none of them suffered any injury whatever.

Much diversity of opinion was expressed by the medical gentlemen who investigated the symptoms and held autopsies of the deceased. Some of these gentlemen maintained that a slower transition from the abnormal to the natural pressure would have been less injurious; others claimed, on the contrary, that it was from the too rapid application of pressure in passing from the natural into the compressed air. The fact that the air-lock tenders were in no case affected, although subjected many times during a watch of two hours in the air-lock to rapidly alternating conditions of the atmosphere, at one moment in its normal state in the lock, and five minutes later exerting a pressure of fifty pounds per square inch upon every part of the body, would seem to prove both of these theories unsound, and lead us to believe that in the length of time to which the human system is subjected to this extraordinary pressure, exists the real source of danger, and not from any rapid alternations of pressure to which it is exposed. After the caisson reached the rock, I have frequently, when passing through the air-lock, admitted the compressed air into it so quickly that none but those well accustomed to it could relieve the pressure upon their ears, and yet I felt no ill effects whatever from this rapidly increased pressure; and in going out I have let the pressure off so fast that the temperature in the lock has fallen thirty-two degrees (Fahrenheit) in consequence. These transitions occupied but three or four minutes.

The fact that the air-chamber was briefly visited by thousands of persons, including many delicate ladies, even after it had reached the bed-rock, some remaining as long as an hour in it without any of them experiencing the slightest ill-effects from the pressure, and the fact that no cases of any importance whatever occurred among the workmen after the watches were reduced to one hour, satisfies me that this is the true cause of the paralysis, and that by lessening still more the duration of the watches, a depth considerably greater can be reached without injury to the workmen. Too long a continuance in the air-chamber was almost invariably followed by symptoms of exhaustion and paralysis. Dr. Jaminet, on one occasion, remained in two and three quarter hours when the depth was over ninety feet, and was dangerously attacked soon after reaching home.

Symptoms of paralysis rarely occurred in the shaft, but generally after the stairs were ascended, and never in the air-lock or air-chamber.

A large amount of money has been gratuitously expended by the company in assisting and providing for those who were seriously affected, and in relieving the wants of their families during their illness.

As a merited recognition of the courage, fidelity and services of the men employed in the air-chamber of the east-pier; and as an evidence of my personal appreciation of their faithfulness and good conduct, I have placed in the appendix to this report the names of those engaged in he work when the pier reached the rock.

THE WEST PIER.

The sinking of the west pier began on the fifteenth day of January of last year, that being the day on which the first stone was laid on the caisson. As it was commenced twelve weeks later than the east pier, advantage could be taken of the experience gained in sinking the latter. On the east pier the interruption and annoyance caused by the necessity of riveting on the iron plates outside of the masonry to exclude the water, as the pier descended, led me to devise some means whereby this inconvenience might be prevented and the cost of the iron saved. The design of the west caisson was so modified that the use of these plates could be abandoned after the first twenty-nine feet; nine feet of this height being the air-chamber, and the remaining twenty feet enveloping the masonry above the chamber. This height of plate iron was deemed requisite to give such rigidity to the caisson as would insure it against any twisting or straining that would endanger the bond of the masonry. After a depth of forty or fifty feet was reached by the east pier, it was found evident that brick linings in the shafts, although surrounded by many feet of masonry carefully laid in hydraulic cement, were not sufficient to exclude the water, which at this depth filtered through quite rapidly. To prevent this and enable the iron around the outside of the pier to be dispensed with on the west pier, its shafts were lined with white pine staves, three inches thick in the center shaft, which was ten feet in diameter, and two and a half inches thick in the smaller wells, which were four feet nine inches in diameter. This device answered admirably, and the estimated saving in plate iron over the original design was about $10,000. The lower staves were, however, found to be too weak to sustain the high water of the spring freshet without expansion bands of 1x3 inch bar iron, which were placed against them in the shafts in time to avoid any disaster. This novel feature of wooden linings and no exterior envelope for the masonry, will be introduced in the east abutment. The caisson for it is, however, made so strongly, that the iron will only be brought up

to a height of twelve feet around the base of the masonry. The lining staves in its wells will be so much stronger that they will require no internal supporting rings of iron.

Nothing could have exceeded the perfect working of these economic improvements in sinkig the west pier, had not the contractors failed to deliver the granite for it in time. When the point was reached at which the granite became necessary, the surface of the masonry was six or eight feet above water and the base of the pier eighteen or twenty feet from the rock. A judicious view of the case, having reference solely to the cost of constructing this pier, would have dictated a suspension of the work until the stone should have arrived, rather than continue the sinking of the pier and suffer the top of the masonry to descend below the surface of the water. Other questions, however, were involved of a more serious nature. It was universally conceded that any effort to negotiate the securities of the company would be fruitless unless preceded by an absolute demonstration of the practicability of putting down the channel piers of your bridge upon the bed rock of the Mississippi, through the unusual depths of water and sand that were to be encountered. The east pier was in a similar condition at this time, and there remained no alternative but to continue sinking both, to do which, it was necessary to build up and brace out the iron plates which had been carrred up from the air-chamber around the masonry of the last pier, and thus dam out the water from covering the top of the masonry as it descended below the surface of the Mississippi, so as to be able to resume the laying of stone when the granite should arrive; and as the west pier was without any such iron envelope, it became necessary to attach the wooden walls of a coffer-dam to its sides in such a manner as to exclude the water from the top of the pier. This was done by padding the lower edge of the dam and attaching its sides securely to the masonry, several courses below the top. This answered very well until the last nine inches of this pier was sunk to the rock. Some of the bolts holding down the dam at the south end of the pier gave way, and the friction of the sand, then fourteen feet high on the outside of the dam and nearly to the surface of the water, prevented the settlement of the dam with the pier at this particular point. Two outside courses of the limestone to which it was attached was held up by the dam nearly across the entire end of the pier. This mishap made it necessary to pump away the sand outside this end of the dam, and put down a large pad or wooden covering reaching below the two disturbed courses, then pump out the dam and relay them. This was done at a depth of about seventeen feet below the surface. The dam was not pumped out till the granite arrived, as the water over the pier did not prevent the work in the chamber, access to it being obtained through the wooden shafts or wells which passed down through the water that was over the masonry. This unexpected trouble, and that at the east pier, were caused solely by the failure of the Richmond Granite Company to deliver the granite in time. Its delivery was due several months before it was needed, and yet it was not delivered until several months after it was wanted. The loss to your company, resulting from this failure, I estimate to amount to at least $50,000.

THE EAST ABUTMENT PIER.

The complete success which attended the sinking of the east pier convinced me of the practicability of sinking the east abutment pier to the rock in the same manner. The original plans of the bridge did not contemplate resting this abutment on the rock. It was believed quite practicable to protect its foundation with rip-rap stone, and to secure stability and safety by resting it on piles, which were to have been driven at a distance of fifty feet below low water mark. When the directory of the company were assured of the practicability of resting this abutment upon the bed rock itself, and of thus terminating forever all doubts as to the absolute stability of each one of the four great piers of your bridge, the desire that this, the largest of them all, should be placed on the rock also, was unanimous, although the excess in cost involved over that of the original design was understood to be about $175,000. No less than ten thousand additional cubic yards of masonry *below* the line of the tops of the piling on which it was originally intended to start the masonry, are required to sink the pier to the rock. Consequently below this line, it will require nearly as much masonry as will be contained in the west abutment when the latter is completed.

This abutment, when completed, will contain 22,453 cubic yards of masonry, including concrete and brick work, and will measure in height, from the rock to the top of its cornice, 196 feet 9 inches.

The depth of the rock at the site of the abutment was ascertained by careful borings to be eight feet lower than that at the east pier, or 136 feet below high-water mark.

It is not probable that we shall have to contend with much water or much greater air pressure than that encountered in sinking the east pier. The bed rock at this abutment is ninety four feet below extreme low-water mark, and the river is not likely to be more than eighteen feet above that during the seasons occupied in sinking the pier. Extreme low-water mark is only reached when the river is gorged with ice above the city, and the volume of water below the gorge becomes, in consequence, greatly lessened. The ordinary low water rarely reaches a point within five feet of low-water mark.

In accordance with the wish of the directory, preparations for sinking this abutment to the rock were commenced, and are now nearly completed. The caisson is nearly ready for launching, after which it will be immediately towed into position, and be made ready for sinking. It will cover when on the rock, 5,000 square feet of surface, and is, therefore, about one quarter larger than the base of the east pier. A large trestle-work has been erected immediately east of the site of this abutment, extending a few feet above high-water mark, on which is being placed a portion of the necessary machinery for sinking the caisson. This trestle-work was rendered necessary because of the shallowness of the water on that side of the abutment. On the west side of the caisson one of the derrick-boats used at the east pier will be located, and on the trestle-work will be placed much of the machinery of the other derrick-boat, which was used on the other side of the east pier.

THE EAST ABUTMENT CAISSON.

This caisson will have several novel features in its construction, which I think will make it superior to those used for the east and west piers. The main shaft will have at the bottom two air-locks, each eight feet in diameter, instead of one but six feet. The main shaft will be carried down into the air-chamber ten feet in diameter, instead of but five feet.

The east-pier caisson had six other shafts of four feet nine inches in diameter, with air-locks of the same diameter at the bottom of each. This caisson will have but two other shafts of four feet in diameter, with an air-lock at the bottom of each, eight feet in diameter. These last two shafts are enlarged below the roof of the air-chamber to eight feet in diameter each. The increased diameter of the locks will contribute to the health of the men, as it is sometimes necessary for twelve or fourteen of them to be in one of them at the same time, for several minutes, until the pressures are equalized. As all four of these locks are within the air-chamber, and also at the lower ends of the three shafts, and as about 1,800 cubic feet of space is occupied by them, there will be that much less space to fill in the compressed air when the pier is down.

The center shaft alone will be used for the workmen, unless some unforeseen accident should render it necessary for them to use one or the other of the side shafts, which are provided almost solely for safety. The extra size of the locks makes either one of them capable of holding, in an emergency, all the men that will be in the air-chamber at one time, and hence their security will be increased.

To avoid the labor of walking up a circular stairway about 120 feet high after leaving the air-chamber, the main shaft, in addition to the stairway, will have an elevator or lift to bring the men up. This, it is believed, will contribute greatly to their health. When they are at work in a pressure of forty-five or fifty pounds above that of the natural atmosphere, there ensues a rapid exhaustion of the physical energies. When relieved from duty, a considerable degree of prostration is frequently manifested, and the foremen of the different gangs were, in consequence, instructed by the physician to cause the men to ascend the stairs leisurely, to avoid increasing it. I confidently believe, therefore, that by bringing the men to the surface in the elevator, there will be much less danger of injury occurring from their employment in the air-chamber.

LIGHTING THE CAISSON.

A different method of lighting the air-chamber will likewise be adopted. In the other caissons much inconvenience was experienced on account of the particles of unburned carbon thrown off from the flames of the candles used. The consumption of the candles under the action of the compressed air was much more rapid than in the normal atmosphere. At the depth of one hundred feet they were found to be consumed in about three-fifths of the time required in the open air. Large quantities of smoke were emitted from the flames, and the air was filled with particles of floating carbon which could only be removed thoroughly by placing a rose jet on the nozzle of a water hose in the chamber, and discharging the spray in every direction. Some amelioration of the evil was obtained by burning the candles under an inverted funnel or chimney, communicating with one of the shafts by a small outlet pipe, through which the escape of the compressed air was regulated by a cock, thus creating a draft above the flame by which the smoke was carried off.

The calcium light would probably prove the most satisfactory one which could be employed in the chamber, were it not for the excessive cost of it in this city. For the one hundred and fifty days which will be required in sinking this pier and completing its foundation on the rock, the cost of lighting the three compartments of the chamber with calcium lights would be at least $5,000. By the means devised for the purpose the cost cannot exceed one-fifth of that sum.

The difficulty of extinguishing a flame in an atmosphere of such density caused me to forbid the use of oil lamps in the chamber before a depth of eighty feet had been reached. The clothing of two of the men having taken fire from contact with some of the hand lamps or candles used in the caisson, it was found exceedingly difficult to extinguish the flames. One of them was severely burned, although his garments were almost entirely woolen. It was deemed unsafe to risk the danger of having the clothing of the men saturated with oil from the accidental breaking of a lamp which might, by the same casualty, ignite their garments and thus endanger their lives. The use of oil was therefore forbidden.

At the depth of eighty feet it was found that the flame of a candle would immediately return to the wick after being blown out with the breath. At the depth of one hundred and eight and one-half feet below the surface of the river, I blew out the flame of one of them thirteen consecutive times in the course of half a minute, and each time excepting the last it returned to the wick. Almost as long as a small portion of the wick remained incandescent, the flame would return, and when the glowing particle of two separate candles failed to possess sufficient heat to restore the flame to either, it would reappear at once by placing the luminous parts of the two wicks in contact.

The chamber of this caisson will be lighted by candles contained within glass globes of similar construction to those used in lighting railway carriages. The glass will be of strength sufficient to sustain the external pressure of the condensed air. The chimney will consist of an outlet pipe of one inch diameter, communicating with one of the shafts, and the compressed air will only be admitted within the globe in which the candle is placed, through a small regulating valve. The candle will, therefore, be burning under the normal pressure of air. A stop cock in the chimney will prevent the escape of air from the chamber through the globe, when it is desirable to put in another candle, or to clean the glass.

TIMBER WORK.

Beneath the masonry piers of suspension and truss bridges, it is quite common to employ a considerable amount of timber. Where the pressure upon the pier is a vertical one, this economical substitute for stone is admissable, but in the piers of an arched bridge, where some one span is at times loaded while the others are unloaded, the thrust of the loaded arch has a tendency to oscillate the piers, and with a few feet in thickness of a material so elastic as wood under their bases, this oscillation would prove a dangerous feature. In the abutment piers, where the thrust is only from one side, and oscillation is prevented by the works on shore, timber may be safely used to a considerable extent. To give the desired stiffness to the caisson for this abutment, and avoid the more costly use of iron, the roof the air chamber is made of timber four feet and ten inches in thickness. A large amount of timber is also used in constructing and stiffening the sides of the air chamber, which are ten feet high, and in forming two horizontal trusses or girders through the air chamber. These two girders are each ten feet thick at the top, three and one-half feet at the base, and nine feet in height. They are about seventy-three feet long, and are interlocked at each end with the sides of the air chamber. They divide this chamber into three nearly equal compartments in the direction of the length of the bridge. Communication is made between these compartments by means of two openings through each girder.

The sides of the chamber are eight and one-half feet thick at the top and eighteen inches at the bottom, and are composed of timbers, some placed vertically, others horizontally, and some inclined at an angle of about forty five degrees, and the whole, including roof and girders, thoroughly interlocked together, and bolted with large iron bolts. All of the timber is of the very best white oak, and was squared up with two steam planers belonging to the company. In addition to the iron bolting used, these timbers are thoroughly secured together with large white-oak tree-nails.

The wood work of the caisson has been most admirably executed under the superintendence of Mr. John Dunlap, master of ship-carpenters.

PLATE-IRON WORK.

Enveloping this entire wooden structure is an iron covering riveted together to prevent the escape of the air which is to supply the workmen. This is of three-eighth-inch plate iron, and its sides are increased in thickness at the bottom edge to three inches, by riveting four three-quarter-inch plates together. These extend several feet up the sides. This iron edge extends ten inches down below the wooden sides and forms the cutting edge of the caisson. Every two feet the iron sides are strengthened by vertical angle irons three by seven inches in size, riveted on flatwise on the outside of the caisson. Through these angle bars, bolts one and a half inches in diameter are inserted, and by them the iron and wooden sides are strongly held together. This iron covering extends over the wooden top of the air-chamber and forms a floor, on which the masonry will be laid. The three shafts passing through this floor, by which access to the chamber is obtained, are tightly riveted to it.

The iron sides are carried up twelve feet above this floor, where they will terminate. The masonry above this point will therefore have no exterior envelope such as the east pier had.

Nearly all of the iron used in this envelope was obtained from the hull of the iron gun-boat Milwaukee, the wreck of which was purchased about eighteen months ago. This iron work has been executed by Capt. Wm. S. Nelson, the skilful and energetic contractor who built the caissons of the two channel piers.

WATER-TIGHT LININGS.

The water penetrating the masonry will be excluded from the three shafts by white-pine linings, arranged like the staves of a cask. The staves composing this lining in the main well or shaft, which is ten feet in diameter, will be ten inches thick in the lower part, and will be gradually diminished to three inches at the top. In sinking the pier, the top of the masonry and shafts will be kept constantly built up above the surface of the river.

FILLING THE AIR-CHAMBER.

The most valuable improvement in the design of the caisson will, I think, be found in the method devised for filling the chamber when it has reached the rock. It is a well-established fact that sand constitutes one of the most reliable and durable materials for foundations known, if availed of in positions where it can be securely retained under the structure erected upon it. It is an equally well-established fact that timber, when entirely submerged in fresh-water foundations, is indestructible. These two facts will be relied upon in filling the air-chamber and fixing the foundation of this pier upon the rock. Instead of concrete, sand will be chiefly used for filling the chamber. The sides of the caisson are of great thickness, and are thoroughly interlocked at the corners of the air chamber, and at the ends of the girders. The possibility of the sand surrounding the pier ever being scoured out to the rock, at the site of this abutment, is a very remote one. It is certainly much more improbable than that it may be scoured thus deeply at the sites of the two channel piers. To avoid all danger from this very remote possibility throughout all time, whatever space there may be existing between the timber walls of the caisson and the bed-rock, after the caisson shall have reached it, will be thoroughly concreted, so that these walls will have a substantial bearing upon a solid material, which cannot be affected by any current that may possibly wash the base of the pier. The walls of the air-chamber are so framed as to be sufficiently strong to resist the bursting pressure of the sand within the chamber, caused by the weight of the masonry of the pier and half the side span upon it, even after all the iron used in it shall have been corroded away. The base of the pier is 5,000 square feet in area, and the weight of the entire pier, including one-half of the span, will be about 46,500 tons. The pressure per square foot on the rock would, therefore, be 18,600 pounds. The area of the wooden edge of the caisson, including that of the bottom of the girders, air-locks and shafts, is about 1,256 square feet. This area alone would be capable of sustaining the pier, without any additional support from the sand contained within the air-chamber. Without this sand filling, the pressure upon the wooden base of the caisson (including the locks and shafts) would be about 74,000 pounds per square foot, or 514 pounds per square inch. This pressure is not beyond the power of good white oak to resist, nor would it be sufficient to crush the concrete that will be used in filling the small space between the oak and the rock.

Tests made with our testing machines upon a number of blocks of concrete only six weeks old gave an average resistance to crushing, equal to 1,200 pounds per square inch. Of course, with the integrity of the exterior of the caisson unimpaired, the escape of sand from the interior would be impossible. With the interior compactly filled, the pressure of the superincumbent mass must necessarily be very nearly equally distributed over every part of the caisson, and hence it cannot exceed about 18,600 pounds per square foot.

The tedious process used in concreting the air-chamber of the channel piers, together with the objections to working men at such great depths, induced me to devise some method by which a smaller amount of manual labor could be made to accomplish equally good results. By the plan determined on in this case, I confidently hope to accomplish the necessary work in the air-chamber with a fifth or sixth of the manual labor which was required under the east pier.

This method is so simple as to be readily explained. So soon as the rock shall have been struck by the iron edge of the caisson, the space then remaining between the wooden walls of the caisson and the rock, will be thoroughly concreted. The sand under the two girders will be left intact. The borings indicate that the rock is quite level, and it is not propable that inequalities of more than eighteen inches will be found in it. It is estimated that one hundred cubic yards of concrete will be sufficient to support these walls, forming a bed of an average width of three feet six inches, by two feet six inches in height. This concreting being done, all of the pipes passing vertically through various parts of the pier, and used for air, water and sand-pumps, will be closed at the top, and the pumps, valves and pipes connected with them in the air-chamber will be taken off. There will be nineteen of these vertical pipes, each either four or six inches in diameter, the lower ends of which will be enlarged conically through five feet of their lengths. These pipes being opened at their lower extremities, and one of the inner doors of an air-lock being secured from being clogged by sand, the air from the chamber will be permitted to escape, and the chamber will be filled with water. This being done, sand will be introduced through the various vertical pipes mentioned. By means of plummets in these pipes, we shall be able to determine the height of the sand discharged in them, and when it is near the roof of the chamber the air will be again pumped in, and workmen will be sent in to level it off. By repeating this process two or three times, the chamber can be filled nearly to the roof with sand compacted in the water, which will insure its solidity. The remaining space can then be filled with concrete rammed in under the roof of the chamber. The great thickness of the walls and of the girders where they join the roof reduces the area of the upper part of the chamber very greatly. The upper three feet of it measures only 2,025 cubic feet in area exclusive of the air-locks and shafts.

To fill the air-chamber of the east pier required 1,340 cubic yards of concrete, which was placed in position by manual labor, under an air pressure of nearly fifty pounds per square inch. This pier is twenty-five per cent. larger, and will require only about two hundred cubic yards of concrete to be placed in it under similar conditions; hence the work required to be done in this chamber will be greatly less than in that of the east pier.

WEST APPROACH.

In this approach, which will be entirely of stone, there will be five arches of twenty-six feet eleven inches span, and forty-two feet ten inches in height above the level of the street. The foundations for the piers to support these arches, all rest upon the rock underlying the wharf. These foundations are nine feet by forty-six feet six inches. The one next to the west abutment is the deepest of the five, the rock being forty-one feet eight inches below the city directrix. This foundation is already completed and will soon receive the Missouri rock-faced red granite, which will form the base for the fine cut sandstone, of which the approaches, on each side of the river will be built. The foundation for the second pier of this approach has just been commenced. The foundations for the third and fourth piers are completed and are ready for the sandstone. The masonry already laid in these three approach piers measures 900 cubic yards.

The foundation for the fifth pier will be in the line of the houses fronting the wharf, and has not yet been commenced. The cellars of the houses, where it is to stand, have been blasted out of the solid rock, and this pier will be rapidly and easily constructed when commenced.

THE EAST APPROACH.

The piers for this approach will be built upon pile foundations, none of which have yet been commenced.

There will be no difficulty in completing this approach within the desired time, and it will be more convenient and economical to begin it after the work on the west approach is more advanced. In design it is almost exactly like the west one.

SANDSTONE.

In the selection of sandstone, the greatest possible care has been exercised. This selection was more especially supervised by Col. W. Milnor Roberts, Associate Chief Engineer, who personally visited and carefully inspected every sandstone quarry of any note within available distance of the work. The one selected lies close to the Mississippi river, near St. Genevieve, and is distant about sixty-five miles from St. Louis. The stone is a pure sandstone of a warm yellowish tint. It is of uniform color, free from blemishes, and from the tests made of it promises great durability.

A force has been at work for some time getting out and cutting the stone, and no fear of delay is entertained on account of non-delivery of it in time.

GRANITE.

Colonel Roberts has also devoted much of his time to the selection of the granite used, and to be used, in the construction of your bridge. Several examinations were made by him of the Eastern granites, and almost every quarry from Richmond to Buck's Harbor, in Maine, was visited by him, with a view to obtaining the best and cheapest that could be had. A contract for the first 700 cubic yards was made by him with the Richmond Granite Company, for gray granite. Subsequently, another was made with Messrs. Thomas Westcot & Son, of Maine, for all the gray granite that will be required for the two abutments and the two channel piers. All four of these piers will be faced with granite ashlar above extreme low water mark, except those parts of their sides which are above the springing of the arches and beneath the road way, and inclosed between the spandrels of the arches. This portion, which is much less exposed to the weather and to view, will be of cut and sand stone.

Missouri red granite will also be used as ashlar, but only in the bases of the approaches, and on the T walls of the abutments, and will appear only to the height of the curb stone on the St. Louis wharf, which is nearly the level of the city directrix. For this purpose about 1,400 cubic yards will be required. This granite promises to be equally as durable as the gray, and that which is already laid up in the work is greatly admired, on account of the richness and beauty of its color.

It is to be regretted that proof could not have been given, at an earlier date, of the capacity of a Missouri quarry to supply a material so excellent and desirable. One of the good results of your enterprise, is the discovery and development of this extensive quarry, owned by Hon. B. Gratz Brown, with whom a contract was made last April for 1,400 cubic yards of the stone, a great part of which has been already delivered. This quarry is distant ninety miles from St. Louis and three miles from the Iron Mountain Railroad.

Several hundred dollars were expended by the Bridge Company in fruitless endeavors to obtain the proper quality of gray granite from a quarry in this State prior to this contract, and this discouragement together with the unfavorable results of examinations made of other unproved quarries in this State, created a reasonable assurance that no suitable granite would be discovered in Missouri, in time for our wants. Hence, no alternative remained but to seek for it elsewhere.

TESTS OF GRANITE.

In the Appendix will be found two interesting reports, one from Prof. Felix McArdle and the other from Dr. Eno Sander, chemists of high standing in St. Louis, giving the chemical tests applied by them, and the results produced by these tests upon the samples of red granite now being used in the construction of your bridge.

The very careful experiments and report of Prof. McArdle were made gratuitously.

A resolution thanking him for this generous manifestation of his interest in your enterprise was passed by the Board of Directors of the Bridge Company.

MAGNESIAN LIMESTONE.

The interior of all the masonry will be of magnesian limestone from the Grafton quarries. None of this stone will be exposed to the weather. It is remarkably strong. Many tests of its compressive strength have been made in the company's testing machine, where its resistance has, in several instances, exceeded 17,000 pounds per square inch, which is equal to that of granite.

A curious fact has been developed by these tests, which is that the modulus of elasticity of this stone is about the same as that of wrought iron. That is, a given weight placed upon a wrought iron column and on a column of the Grafton stone of the same size, will produce an equal shortening in both; while the elastic limit (or breaking point) of the stone is not far below the limit at which the wrought iron would be permanently shortened. A column of the stone two inches in diameter and eight inches long was shortened under compression in the testing machine nearly one quarter of an inch without fracturing it. When the strain was removed the piece recovered its original length.

TESTING MACHINE.

The testing machine, the design of which was made by Col. Henry Flad, Chief Assistant Engineer, has been in operation for several months, and has given the greatest satisfaction. By means of a very simple little instrument, suggested by Chancellor Chauvenet, and matured by Col. Flad, the most delicate changes in the length of the specimen can be accurately recorded, with a degree of minuteness never before obtained, or even approximated, in any testing machine, so far as my information extends. By this instrument it is perfectly easy to detect a change in the length of the piece equal to the two hundred thousandth part of an inch.

A brass collar is slipped over each end of the specimen, and these are secured by three pointed set screws in each collar. Any shortening or lengthening of the piece will, of course, alter the distance between the two collars. One collar has on the side of it a small flat surface or vertical table. Against this table is placed a little vertical steel cylinder, which is held against the table by the end of a little flat horizontal bar that is secured at its other end to the other collar. This bar is held against the steel cylinder by a spring, having sufficient strength to keep the cylinder from falling. It is evident now that if one collar be brought nearer, or is moved farther away from the other, the steel cylinder will be rotated, as one side of the cylinder is pressed against the table, which is attached to one collar, while the other side is pressed by the little bar that is fastened to the other collar. If the specimen be subjected to pressure it will be shortened and the collars will approach each other. If tension be applied to the specimen, the piece will be stretched according to its intensity, and in either case the rotation of the little steel cylinder will indicate the measure of the disturbance that has occurred between the two collars, and it will give it absolutely without any element of error entering into it from any change of the dimensions of parts of the machine under strain. By placing on the top of this little cylinder a small vertical mirror, the extent to which the cylinder has been rotated may be determined in the following manner: Twenty-five feet from the mirror an arc of a circle is struck, the little steel cylinder being the center of the arc. On this arc is erected a scale of inches with decimal subdivisions. This scale being illuminated by gas-light can be easily read in the mirror by means of a small telescope placed immediately above the scale. The angles of incidence and reflection at the surface of the mirror being equal, it follows that one-fourth of a complete rotation of the mirror would be equal to a half-circuit of the circle of which the arc is a part; or, in other words, a movement of the mirror of but one degree would be shown on the scale by the reading of a space equal to two degrees, or the one-hundredth part of an inch on the scale would really be only half so much, or the two-hundredth part of an inch, when seen in the mirror. The diameter of the little cylinder is so proportioned to the radius of the arc as to make the smallest subdivision of the scale equal to the twenty thousandth part of an inch, but the observer, after a little practice, can subdivide these divisions, which are magnified by the telescope, so as to observe the two hundred thousandth part of an inch.

The power is applied to the specimen under trial by means of a hydraulic press, the ram of which moves horizontally. The ram has a steel rod extension passing through the rear end of the cylinder. Specimens for testing by tension have one of their ends secured to this steel rod, and the other to the end of a scale beam. Specimens for crushing are placed at the other end of the cylinder, and are compressed between the end of the ram and a crosshead. This crosshead is attached to the end of the scale beam before mentioned by four powerful rods of steel surrounding the cylinder and leading back to a crosshead attached to the beam. This latter crosshead is detached from the beam when tensile experiments are being made.

It will be obvious, on reflection, that when a piece is being crushed by the thrust of the ram, the four bolts sustaining the crosshead against this thrust must stretch in proportion to the power applied, and hence the specimen will be moved bodily in the same direction, and that this will affect the accuracy of the readings of the mirror, as it too will be moved horizontally with the specimen to which it is attached. To correct this minute error in the readings, a second mirror and scale are used to ascertain the extent of this horizontal movement. The table holding this second mirror, against which the little cylinder rotates, is secured to the frame of the testing machine, which has no strain on it, and the little bar for rotating the cylinder is attached to the crosshead; of course, any movement of this head causes a rotation of this second mirror, by which the extent of the movement can be at once ascertained.

It is equally important to know the exact weight applied to the specimen, as well as the change of form assumed by it when subjected to the weight. Having no faith in the accuracy and durability of the ordinary mercury and spring gauges for such high pressures as are required in a hydrostatic testing machine, I determined that the absolute strain on the piece must be weighed on the balance. This, Colonel Flad has very ingeniously accomplished by a system of levers, balanced on hardened chrome-steel knife edges and boxings, sufficiently powerful to stand a strain of one hundred tons, and yet so delicate as to be turned by the weight of one-half of an ordinary cedar-covered drawing-pencil, when placed in the balance. One pound weight placed in the balance equals a ton of two thousand pounds weight on the specimen.

I feel safe in asserting that the company have a testing machine which can scarcely be excelled in the accuracy, delicacy and minuteness of its results.

It has been placed in charge of Mr. Paul Dalhgren, C. E., by whom a carefully tabulated record is kept of all tests made with it. A great variety of these have already been made upon specimens of steel, iron, woods of various kinds, granite, brick, limestone, concrete, cement, models of tubes, trusses, etc., etc. Much valuable information having direct reference to the work in hand, has been already obtained by these experiments.

[TO BE CONTINUED.]

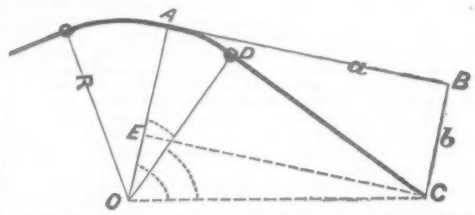
—In 1864, the Minnesota Central Railroad Company imported 3,000 tons of railroad iron upon letters of credit issued by J. Pierpont Morgan & Co. The latter insured the iron on an open policy in their own names, in the Atlantic Mutual Insurance Company, at an expense for premiums of $7,025. This amount was allowed and paid to J. Pierpont Morgan & Co., upon a settlement of accounts between them and the railroad company. In 1865 the insurance company made a scrip dividend of 40 per cent. on its business of 1864, which included $2,800 to J. Pierpont Morgan & Co., on the insurance in question. This scrip the railroad company claimed to belong to them as a matter of right. Morgan & Co. claimed it under an alleged usage of trade. The New York Court of Appeals has recently decided that the railroad company, in the absence of any special agreement, were entitled to it, and that the alleged usage, even if established, did not control. This is in opposition to a decision made by the Chamber of Commerce, made as long ago as 1844.

—A fresh section of the Bavarian State Railway was opened for public traffic on the 1st of May. It is 13½ German miles in length, and runs from Munich in an easterly direction towards the Austrian frontier at Braunau, where it will form a junction with the railroad system of that empire, and considerably shorten the distance between Munich and Vienna. The last remaining section of this important line will be completed and opened for public traffic in the course of this summer.

Contributions.

LAYING OUT RAILROAD CURVES.

Mr. L. Wagoner sends from Lawrence, Kansas, a third solution of the problem stated and solved by a correspondent some weeks since. The method Mr. Wagoner gives is a correct one, though scarcely an improvement, in simplicity and ease of solution, to the first submitted:



"Having seen so many complicated solutions of the problem on page 76, May 13, 1871, of the RAILROAD GAZETTE, I beg leo to offer the following solution: Let R denote radius, a the tangent or latitude, and b the distance from the tangent or departure. Let $E\ C\ O - v$, $D\ C\ O - v'$; then $D\ O\ A - v' - v$, the required angle. By trigonometry, we have $\frac{R \pm b}{a}$ — tan. v, and $\frac{R \cos. v}{a}$ — sin. v'; from which the problem is at once solved. The + sign is used when the tangent falls out of the curve, and the − sign for tangent falling inside. For example, let $R = 1{,}042$ — 5° 30' curve; let a — 1,680 and b — 680, which is about the proportion of the figure above. Then $\frac{1{,}042 - 680}{1{,}680}$ — .21541 — tan. 12° 10', and $\frac{1{,}042 \times .9775}{1{,}680}$ — .60636 — sin. 37° 19', and 37° 19' − 12° 10' — 25° 9'—which is the required angle to advance on the curve."

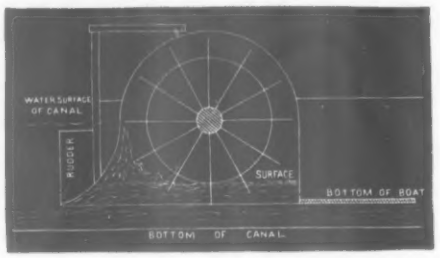
STEAM ON CANALS.

BALTIMORE, June 15, 1871.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Having lately read that the Legislature of New York had offered a reward of $100,000 for the invention of a method by which a canal-boat could be propelled with steam at the rate of three miles an hour without creating a wave which would injure the embankments, I desire to offer, through your columns, a suggestion which has been approved by all to whom I have referred it.

Let an ordinary paddle-wheel be encased with an air-tight chamber opening at the bottom into the water;



both the wheel and the chamber to reach nearly as low as the bottom of the keel. The openings in the sides, through which the shaft passes to the journals outside, to be secured aginst the escape of air by the application of India-rubber or other elastic material. A small air-pump, worked by the steam engine which turns the wheel, will compress the air and keep the surface of the water inside of the chamber to the point where the wheel will have, under all circumstances, the most effectual submersion; to be regulated by a gauge and valve. The side of the chamber next to the stern to flare backward at the bottom at an angle sufficient to give the propelled water a downward movement while offering the least resistance to the progress of the boat, and to enable the air, entangled with the water, to escape into the chamber before being forced outside; the wheel and the engine to be placed in the stern so that, when the boat is empty, the greatest submersion will be at the wheel and the resistance at the front diminished. For economy of space I would place the boiler upright in front of the wheel and the cylinders horizontal on each side of the boiler.

The effect of this arrangement will be:

1st. Uniform and regulated submersion of the wheel.

2d. Reaction of the propeller against the densest strata of water.

3d. Causing the propelled water to rush below the surface of that in the canal and to impinge upon the bottom.

RD. RANDOLPH, Civil Engineer.

CAMDEN STATION, BALTIMORE.

[We apprehend that the difficulty in this arrange-

ment will be to keep the chamber filled with air of a uniform pressure, as very large quantities would be carried out with the water on account of the agitation of the wheel.—ED. GAZETTE.]

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD.

Annual Report for the Year Ending March 31, 1871.

PRESIDENT'S REPORT.

During the past year the affairs of the company have worked smoothly, business has been very fair, no serious accidents have occurred, reductions in operating expenses have been made, cost of transportation of freight and passengers reduced, corresponding reductions have been made in charges, to the gratification of producers and shippers along your lines of roads, the road-bed and equipments generally were never in better condition, and the Board of Directors think they may well congratulate you upon the success and future prospects of the company.

The new bridge being built by the government and this company across the Mississippi is not yet completed. The delay is occasioned by no fault of this company, as the government undertook to build across the main channel itself. That part of the work being done by the company, to approach the main bridge, is well advanced, and will easily be completed before the government will be ready to allow our trains to cross the main channel.

A suit has been commenced to reach certain assets of the Mississippi & Missouri River Railroad Company in the hands of a receiver to reimburse this company for one-half the amount paid to redeem the Railroad Bridge Company bonds, as stated in the last annual report.

The bonds of the Chicago & Rock Island Railroad Company, due July last (being the only indebtedness of that company), have been paid, except $104,000, not yet presented for payment.

The gross receipts, from all sources, for the year ending March 31, 1871, were		$6,028,287 29
The gross expenditures, properly chargeable to earnings, were		3,405,459 06
Leaving as net earnings		$2,622,828 23
From this sum there has been paid, interest on bonded debt	$617,751 75	
Dividends, including government tax	1,229,466 00	
Rent Peoria & Bureau Valley Railroad	125,000 00	1,972,217 75
Surplus		$650,610 48
Add this to balance of income account, March 31, 1870, ($2,064,767.41), and the balance of income account on the 31st day of March, 1871, is		$2,719,377 89

The report of the General Superintendent, herewith submitted, enters into details so fully, and shows so compeltely the working of the road, and all matters connected with it, that further remarks upon those points here are unnecessary.

CHICAGO & SOUTHWESTERN RAILWAY.

This company have made good progress during the last year in the construction of their line of road, and have 145 miles in operation, from Washington to Princeton. There are also 54 miles completed and in operation from the Missouri River to Cameron, on the Hannibal & St. Joseph Railroad. It is expected that the road will be completed ready for use the whole distance from Washington to Leavenworth in the month of August next.

That part of the road east of Princeton is being opperated by your company. No definite and final contract as to terms of operating has yet been made, but probably soon will be.

A large increase of equipment will be necessary when this line shall come into full operation, and, in view thereof, the company have contracted for twenty-five locomotives, which are now in course of delivery, and it is proposed to build an increased number in the shops of the company, at Chicago, during the present year. It will also be necessary to procure a largely increased number of cars, and it is proposed to purchase whatever may be required that cannot be manufactured in the shops of the company.

LAND GRANT.

The Land Commissioner reports that the grant has been pretty much adjusted; that during the past year he has received from the Interior Department certificates for 160,373 10 100 acres, under the act of Congress of June, 1864, which is all that is claimed, except some few scattering tracts now in course of investigation at Washington.

Sales have been made during the past year of 28,022 8-100 acres, for the sum of $213,575.39, an average of $7.63 per acre. In addition to this, there has been received something over $4,000 from compromise of the title to about 2,000 acres of "rejected swamp selections," referred to in the last annual report. The sales have been made almost exclusively to actual settlers, in small tracts, and farms are being opened up on nearly every tract. The market price of lands has increased during the past year in nearly all the counties where the company's lands are situated, and it is expected that the average price of lands sold during the coming year will be fully $8.50 per acre. Such steps as have been deemed advisable have been taken in the way of advertising, publication and distribution of maps and pamphlets, to induce immigration along the line of the company's land, and a large increase of population is expected in the cennties west of Des Moines, along the line of our road.

The Board of Directors have, during the past year, provided for a sinking fund to retire the mortgage bonds of the company, and the net proceeds of sales of these lands will be paid over from time to time to the Commissioners of the Sinking Fund and invested by the purchase of such bonds.

It has been determined to extend the Washington Branch of the company's road to Sigourney, in Keokuk County, a distance of about thirty miles. Surveys have been made and construction will soon begin.

The proposed construction of other roads has rendered the extension of this branch a necessity, in order to retain the business properly belonging to this company.

JOHN F. TRACY, President.

CHICAGO, June 7, 1871.

REPORT OF THE GENERAL SUPERINTENDENT.

The following report of the condition of the Chicago, Rock Island & Pacific Railroad, and the results of its operation for the year ending March 31, 1871, is respectfully submitted.

The gross receipts and expenditures have been as follows:

RECEIPTS.

From passengers		$1,713,123 16
" freight		4,023,271 60
" mails		83,190 63
" express		83,543 70
" rents		82,220 42
" interest on loans, etc.,		42,337 78
Total		$6,028,287 29

EXPENDITURES.

Operating expenses	$3,218,610 43	
Legal "	24,884 43	
Taxes on real estate and U. S. government tax	161,964 20	3,405,459 06
Net earnings		$2,622,828 23
Rent of Peoria & Bureau Valley Railroad	$125,000 00	
Interest on bonds	617,751 75	
Dividends, including tax	1,229,466 00	1,972,217 75
Surplus earnings		$650,610 48
Percentage of operating expenses to gross earnings		53 39-100
" " " including taxes and legal expenses		56 50-100

A comparison of the foregoing figures with the last annual report will show that while the earnings from passenger traffic have fallen off $73,833.57, or 4 13-100 per cent., the receipts from freight have increased $436,269.40, or 12½ per cent., showing an actual increase in the earnings of the road, exclusive of the item of interest etc., over the earnings of 1869 and '70 of $385,292.10.

A further examination of the detailed reports will show that while there was a considerable increase in the total number of passengers carried, there was a decrease in the number of through passengers, in the average distance traveled and the rate per mile paid, owing to the competition and diversion of travel by new lines of railroad opened during the year.

There has been expended during the year on account of construction and equipment as follows:

Land and land damages	$589,843 85
Equipment	349,369 04
Grading, including masonry	209,724 00
Superstructure and bridging second and side tracks	122,6[illegible]0 54
Quarrying stone and ballasting track	[illegible]6,645 86
Station buildings, shops and fixtures	133,342 89
Water stations, artesian wells, etc.,	20,190 7[illegible]
Fencing account	16,098 77
Engineering account	4,282 76
Chicago new shops (including tools and machinery)	31,076 40
Railroad bridge at Rock Island (new)	37,158 41
3,[illegible]11 tons steel rails (excess in cost over iron	59,931 78
Cattle guards, sidewalks, drains, etc	2,859 71
Total	$1,718,184 51

The first item includes amount paid for land purchased in city of Chicago (river front), and right of way through the city of Davenport to new railroad bridge.

Equipment includes cost of twelve locomotives and expenditure to date on account of six more in course of construction. Also cost of two sleeping coaches, one day coach and two hundred and ten freight cars of all descriptions.

Track laid with re-rolled rails	30 46-100
Track laid with steel rails	33 24-100
Track laid with steel-capped rails	1 13-100
Total laid this year	64 83-100
Total steel rails in use	63 14-.00

The steel rails continue to give entire satisfaction. Those that have been the longest in service show but slight evidence of wear, and more fully demonstrate the advantage and economy of adopting steel for lines of heavy traffic.

The average cost of steel rails, in currency, was	$101 59 per ton.
The average cost of re-rolling iron	33 09 " "

There are now in use 21 miles of second track on Illinois Division, viz.:

From Englewood to Washington Heights	5¼ miles.
From Seneca to Marseilles	4¾ "
From De Pue to Bureau	4¼ "
From Port Byron Junction to Rock Island	6¾ "
Total	21 "
Increase since last report	10 "
Miles side track date of last report	98½ "
Miles added during year	10 "
Total miles side and second track	129 "
Add main and branch lines	590 "
Equal to single track of	719 "

The equipment of the company consists of 145 locomotives—all coal burners but two, 10 sleeping coaches, 53 day coaches, 3 railway postoffice cars, 23 baggage, mail and express cars, 60 caboose and drovers' cars, 1,858 box freight cars, 267 stock cars, 780 flat and coal cars, 2 pile driving cars, 1 wrecking car, 1 pay car—3,058 cars. There have been added during the year, by purchase, eight locomotives and 97 freight cars. And four locomotives, two sleeping coaches, one day coach and 113 freight cars constructed in the company's shop and charged to equipment account.

It gives me pleasure to report the motive power of the road in excellent condition, and the economy and efficiency with which the repairs have been made reflect much credit on the Master Mechanic and his assistants in the various shops.

In car department, one passenger coach, eight baggage and express cars and 51 freight cars have been built, to take the place of the same number of cars worn out or destroyed, and their cost charged to repairs.

Number of passengers transported during the year, 708,815.

First class	693,439
Second "	12,751
Third "	2,625
Through Passengers	62,865
Way "	645,950
Passengers going east	337,972
" " west	370,843

Passengers carried one mile, 44,609,479; equivalent to carrying each passenger 62 93-100 miles. Average per mile per passenger, 3 84-100 cents. The sleeping cars owned and managed by the company have earned $47,307.25. Attendance, washing and lights cost $9,003 53.

	Pounds.
The amount of freight transported during the year	1,828,690,104
During previous year	1,713,335,409
Increase	115,354,695

or 57,677 tons.

Freight carried one mile, 151,864,519 490-2000. Equivlent to moving each ton 166 miles. Average earnings per ton per mile, 2 64-100 cents.

Number of loaded cars moving eastward	59,380	
" " " " " westward	67 575	126,955
Average tonnage to each loaded car		7 404-2000

Increase of tonnage movement, 16 per cent.

Receipts from Freight, 1870 and 1871	$4,023,269 40
" " " 1869 and 1870	3,587,002 20
Increase	$ 436,267 40

or 12¼ per cent.

[We omit from this report of Mr. Riddle, the General Superintendent, some interesting statistics, for which we are not able to find room this week.]

BALANCE SHEET OF THE CHICAGO, ROCK ISLAND & PACIFIC RAILROAD COMPANY, APRIL 1, 1871.

CREDIT BALANCES.

Capital stock account	$16,988,400 00
Fractional scrip, convertible into stock	11,600 00
Bonds, Chicago & Rock Island Railroad Company	104,000 00
Income bonds, Chicago & Rock Island Railroad Co.	13,000 00
Mortgage sinking fund bonds	8,000, 0 00
Fractional agreements, convertible into bonds	643 37
Chicago, Rock Island & Pacific Railroad Co., of Iowa.	29,681 94
Sundry balances	30,295 83
Profit, balance of income account	2,719,377 89
	$28,496,999 03

DEBIT BALANCES.

Cost of road and equipment	$26,7[illegible] 3,243 45
Securities in hands of trustee for guaranteed bonds	[illegible]2, 57 46
Railroad bridge bonds	387,136 49
Cash and loans payable on demand	833 9[illegible]8 93
Balance in hands of Assistant Treasurer, Chicago	25,500 [illegible]0
Balance in hands of Cashier, Chicago	4[illegible]5,082 70
	$28,496,999 03

The Rhigi Railroad.

This interesting mountain line, which, being only 4¼ miles long, in that space overcomes an elevation 3,770 feet, was opened for traffic on the 22d of May last, a trial trip, with perfect success, having been made the day previous. The following description is from the directors' account:

"The whole length of the railway from the abovementioned Vitznau to the frontier of the Canton of Schwyz, at Staffelhohe, is 5¼ kilos, or 16,140 feet, the vertical height of the last-named place above the level of the lake being 1,113 meters. The run of the straight lines is 3,417 meters, and that of the curves 1,724 meters, the latter having a radius of 189 meters. With the exception of a stort horizontal slip of 45 meters at the Vitznau station, and one of 39 meters at Staffelhohe, the whole line consists of gradients, the maximum being 25 in 100, the minimum 6.6, and the average 22. In addition to the two terminal stations, it is proposed to make a water station, with sidings, to allow other trains to cross or pass at Freiberg, half-way up the mountain, another at Folsenthor, and a third at Kaltbad. The most remarkable objects of engineering work on the line are the cutting in the rock just above Vitznau, the tunnel at Schnurtobel, the bridge over the chasm at the same place, and the cutting at Eichberg. The rolling stock at present consists of three locomotives, which are differently constructed from those used on more level ground, inasmuch as they have upright boilers, and their driving axles are furnished with cog-wheels, which secure them a firm hold or grip on a cogged rail—three large passenger carriages, with accommodation for 54 persons each, and two smaller ones fitted with thirty seats each. The company's capital of 1,250,000 fracs, all paid up, was found to be insufficient to cover the total expenses, which have amounted to 1,501,897 francs; the excess, caused partly by an alteration and extension of the original plans and estimates, and partly owing to the difficulty of obtaining the needful number of skilled workmen, in consequence of the disturbed relations between the neighboring States of France and Germany, had, therefore, to be raised by a small loan on mortgage, to be repaid out of the receipts of the line in certain stipulated proportions according to the annual amount of the earnings."

Tickets Around the World.

Mr. Francis Colton, late General Ticket Agent of the Union Pacific Railroad, started on a trip around the world, to introduce the tickets of the Union and Central Pacific roads in Australia, Japan, China and India, and establish a system of coupon tickets in connection with steamer lines on the Atlantic and the Pacific for trips around the world. Mr. Colton has now completed his task, and soon coupon tickets will be offered at leading points in the world for passage around the globe. The price of tickets in London, where they are now on sale, is £225; in American currency it will probably be $1,250. The time for this journey will be only about 80 days. Several steamer lines between New York and Europe enter into this arrangement, as does the great Peninsular & Oriental Steamship Company of England. Although the number of persons making the round trip is not likely to be very great, a considerable increase in travel between Europe and the Eastern coast, and Asia and Australia, may reasonably be expected.

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

CONTENTS.

	Page.
ILLUSTRATIONS.	
The Illinois & St. Louis Bridge — Double sheet and page 155.	
Railroad Curves	158
Canal Boat Propulsion	158
CONTRIBUTIONS.	
Laying out Railroad Curves	158
Steam on Canals	158
SELECTIONS.	
The Illinois & St. Louis Bridge	155
The Rhigi Railroad	159
EDITORIALS.	
Color and Cast-Iron	160
EDITORIALS.	
The Car-Builders' Convention	160
The Illinois Railroad Laws	161
The Rock Island Report	161
NEW PUBLICATIONS	161
GENERAL RAILROAD NEWS.	
Chicago, Rock Island & Pacific Report	159
Elections and Appointments	162
Mechanics and Engineering	162
Miscellaneous	162
Chicago Railroad News	163
Old and New Roads	163
Traffic and Earnings	164

Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, *if not previously published,* FREE OF CHARGE. *They are invited to send us drawings or models and specifications. When engravings are necessary, the inventor is expected to furnish his own engravings, or to pay for them.*

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

***Engineering and Mechanics.**—Mr. M. N. Forney, Mechanical Engineer, whose office is at Room 7, No. 72 Broadway, New York, has been engaged as Associate Editor of this journal in charge of these departments. He is also authorized to act as our agent.*

☞ *Our Prospectus and Business Notices will be found on the last page.*

THE CAR-BUILDERS' CONVENTION.

Last week we gave a tolerably full report of the proceedings of this convention. A few words of comment may not be amiss now.

The minds of railroad men, we find, are very much divided with reference to the usefulness of assemblages of this kind. Some assert, in the strongest terms, that they result in no good, and that their only object is to enable the members to have a "high old time." Others are equally decided in believing that they can accomplish any desired reform which relates to the speci l duties of the members; while a third class stand afar off and sneer at the whole thing generally, taking good care to be near enough to come in if there should be any credit or other good thing to distribute.

Perhaps it is hardly necessary to say that none of these views are entirely correct. That the only object for which the members attend them is the enjoyment of "riotous living" (of which, we regret to say, there always is more or less) is, of course, palpably absurd, as any one can see who has once been present at a convention of this kind. That they can bring about any desired reform in their own calling is also far from the truth. The fact is, the convention is made up of men who are characterized—like all the rest of mankind—with a great deal of human nature. Some of them are clear-headed, others prone to get mixed up. Some will agree to almost anything proposed; others would dissent from the ten commandments if they were up for discussion. Some are silent and never express their opinions to the association on any subject, while others have such a fondness for hearing themselves talk that they are seldom silent ten consecutive minutes. Very few of them are familiar with the rules of parliamentary debate, consequently much time is wasted and many things left undone which should have been discussed, and others decided contrary to the wishes of the majority, because those interested in the matter could not see how to present the matter before the association. Now when such incongruous elements are brought together, it is not surprising if their deliberations are not all characterized with the wisdom of Solons, or their proceedings quite so regular as a trial in a court of justice. Nevertheless, there are many things which can be determined by a simple vote, and on which almost any decision is better than none. Take, for example, the height of draw-bar of cars. It is not so very important what the height—within certain limits—should be as that *some* height should be fixed upon. So of screws and threads. What is wanted is some standard. The convention, as will be seen from its proceedings, agreed to recommend a standard for the height of draw-bar and also for screws and threads. Now, although this may seem like a very trivial result for so much time, trouble and money expended in holding the meeting, yet these could hardly be determined upon in any other way than by a conference of railroad officials, and who among them is so competent to do it as the car-builders?

It must also be remembered that much of the good accomplished by such meetings never appears in the minutes of the association, but is the result of the intercourse of the members with each other, and also of travel and seeing the way which other people have adopted for doing their work or managing their business.

In speaking of what the convention at Richmond did, we do not desire to convey the impression that the only business transacted, or rather accomplished, was to fix upon a standard for screws and threads, and the height of draw-bars, but only cite these as very palpable examples of what such associations have done and can do.

That the Master Car-Builders' Association might accomplish much more than they do, is of course true; but then more enthusiasm in the cause would be necessary, and more time would be required to be given to the collection of data and statistics. The thing which chiefly concerns us now is, what they do accomplish with the existing material which they have to work with. We cannot help thinking that if they had an officer employed by them who could give the necessary time to the collection of information, to the preparation of the material for reports, and to be, to a certain extent, a sort of executive officer, that much more could be done which would be of permanent value. An association of this kind which is purely voluntary is always in danger of falling to pieces from the want of cohesion. An officer of the kind we refer to could, during the year, visit the members, call their attention to what the association needs, and by communicating to them the objects and aims for which it is organized, interest them in its proceedings, and lead them to supply such information as is sought. Quite a number of the committees this year had no reports at all. Other reports were obviously prepared in great haste, and often without a conference of the members of the committee. Notwithstanding this, they elicited much valuable discussion when the subject matter of the report could be reached.

After the report on dead weight had been read, a good deal of remark followed, and we believe all who spoke were unanimous in the opinion that the chief reason why the weight of freight cars cannot be reduced is because they are so frequently overloaded. When this is done, cars, if made light, break down, and the blame is laid upon the car-builder. In self defence, therefore, he is obliged to make them heavy in order to have the extra strength required. If this is so, and railroads are all carrying from 10 to 20 tons more dead weight than is necessary, it seems as though those in charge of the transportation departments are the persons who must be looked to for a cure of the evil. If a more rigid enforcement of the rule against overloading cars would make it possible to reduce their weight, it would certainly be worth the while for those in authority to enforce the law with all the rigor possible. It seems probable, however, that if the size of the cars was reduced it would do much to prevent their being loaded with an excessive weight.

While it is probably true that the reason assigned is one of the chief causes why the weight of cars is so heavy, there is also another question which might be asked, which is, whether the weight might not be reduced without lessening the strength? One of the speakers spoke of using the very best material in every part, and disposing of it to the best advantage. Undoubtedly much might be done in this way, and by designing cars skillfully they might be made lighter without being weaker.

On warming and ventilation there was also much said, but a good deal of misapprehension seemed to prevail on account of the confusion of summer ventilation with that required in winter. For some reason which is not plain, many people cannot be made to believe that fresh, pure air is as requisite in cold weather as in warm, and, therefore, whenever the question of ventilation is brought up they think of nothing excepting some way of excluding the dust from cars. We venture to say again what we have said before, that the problem of ventilation in winter is, how to admit fresh air; and unless this is properly done it will be impossible to keep the air pure, in a car filled with people. Various plans were discussed, and that designed by Mr. Garey of the Harlem Railroad and illustrated in the RAILROAD GAZETTE of March 25, 1871, was spoken of most favorably. All who have used it agreed that it worked very well, and that there was hardly a possibility of its getting out of order.

All the other topics on which reports were made elicited discussion, and it is to be regretted that most of it will not be preserved in any permanent form.

The reception of the members of the convention by the citizens of Richmond was all that could be desired, and nearly all who were there came away with a kindlier feeling for the Southern people, and much gratified by their visit.

COLOR AND CAST IRON.

Every year cast iron is coming into more extensive use as a material for buildings. Its exposure to the atmosphere is almost always attended with slow but sure destruction. Silently and almost imperceptibly corrosion goes on, so that time alone is the element which will decide the life of an iron structure, unless it be protected from this subtle enemy. In nearly all cases paint is the material used to exclude the destroyer. Inasmuch as the color of paint has but a very slight, if any, influence on its cost or durability, there is an opportunity for the exercise of fancy, taste or caprice in the hue of iron buildings. Until recently white was regarded as the only color which was suitable for a building of any pretentions, so that we have had buildings like Stewart's up-town store in New York, and other imposing "fronts," decked out in perfectly dazzling mantles of white. Of late, however, the practice has come into vogue of using some variety in the color of iron buildings. One of the first examples of this kind was Tiffany's new store on Union Square. The upper portion of this building is painted a dark drab color, and the lower story black, with gilt mouldings. The effect is very striking, and has the commercial advantage of bringing out in strong contrast the goods which are displayed in the window. It attracted much attention at once, and there were a great many imitations of it, and now almost every block on Broadway has an example of a store with the lower story painted in black and gold.

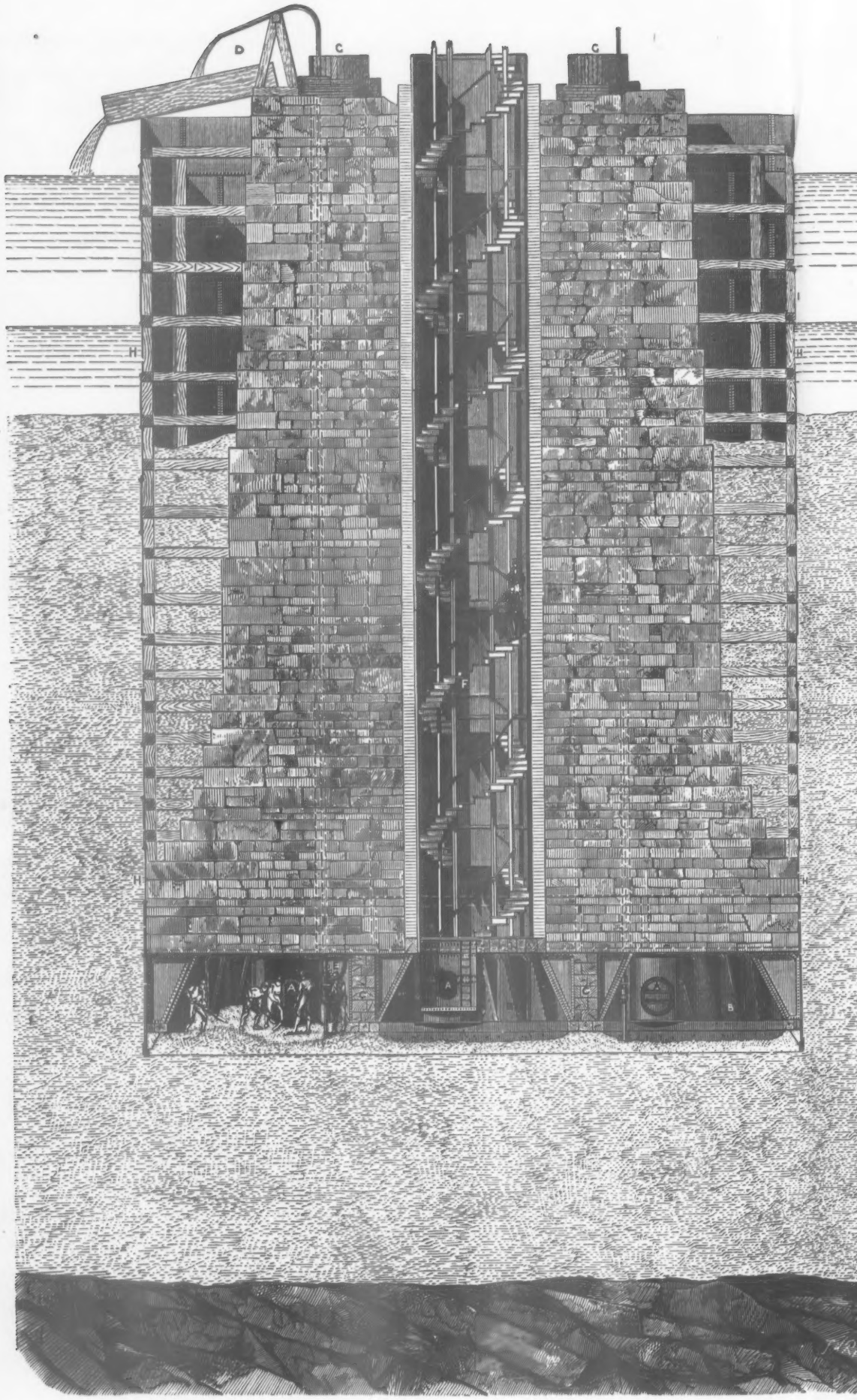
Several large buildings, such as Lord & Taylor's dry-goods store, corner of Broadway and Twentieth streets, have been painted drab or neutral tint. The effect, however, without any other color, is not pleasant, as it produces a sort of dead appearance.

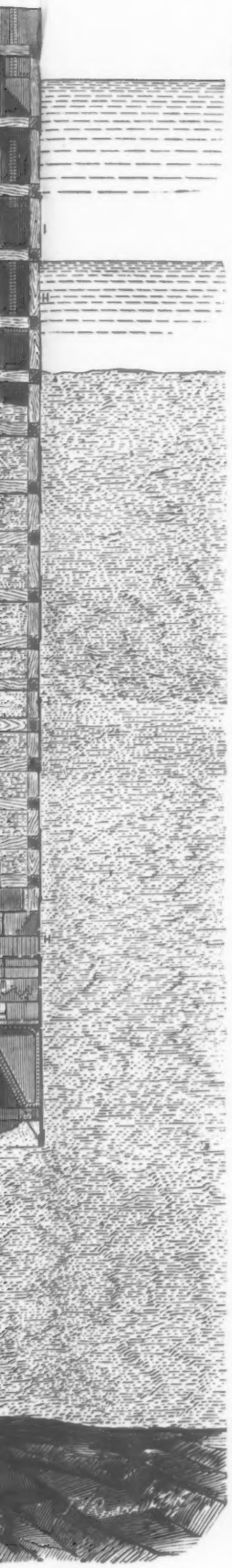
In building their new store on Broadway, they adopted two new ideas, or at least two which thus far had not been put into practice in any building of any pretension in New York. In the first place cast iron was employed in a manner suitable to the nature of the material. Heretofore, with the exception of the structures designed by engineers, nearly all buildings made of iron have been built in imitation of stone. Now, obviously, the construction of a building to be made of a material whose power to resist a strain of compression is ten times greater than stone should be very different from that of one built of the latter material. When we take into consideration, too, that we can combine wrought iron—whose tensile strength is probably more than a hundred times that of stone—with cast iron, it is obvious that the whole construction of an iron building should be based upon laws wholly different from those upon which we construct a stone building.

The architect of the new store for the Messrs. Appleton have recognized this, and instead of forming their front of columns cast of a thin shell of cast iron and made of a large diameter so as to represent stone, and thus obstruct the light and lessen the width of the entrances, he has made the whole front as light as possible, with the material used. By this means he has economized material and admitted as much daylight into the building as possible, and at the same time made a very graceful front. With such a construction there is of course not so much opportunity, or rather not so much space, for ornamentation. To compensate for this he has used a variety of color. The body of the building is painted a yellowish drab or buff color. The panels and some of the receding parts are red, and the projecting moldings gilded. The effect is very striking and has been very much admired.

The building immediately adjoining the Appletons is of a somewhat similar construction, but not so light, and the upper stories are painted blue, with dark red panels and gilded moldings and projections. The lower story is black, red and gilt. The colors do not contrast well with those in the Appleton building, although the general effect would be good in any other location.

Another very good example of the use of color is the lower story of the Hotel Brunswick, on Madison Square, which is painted a sort of olive color, with light green moldings. The appearance is not unlike


D
C
C
H
H
F
F
A
A
B



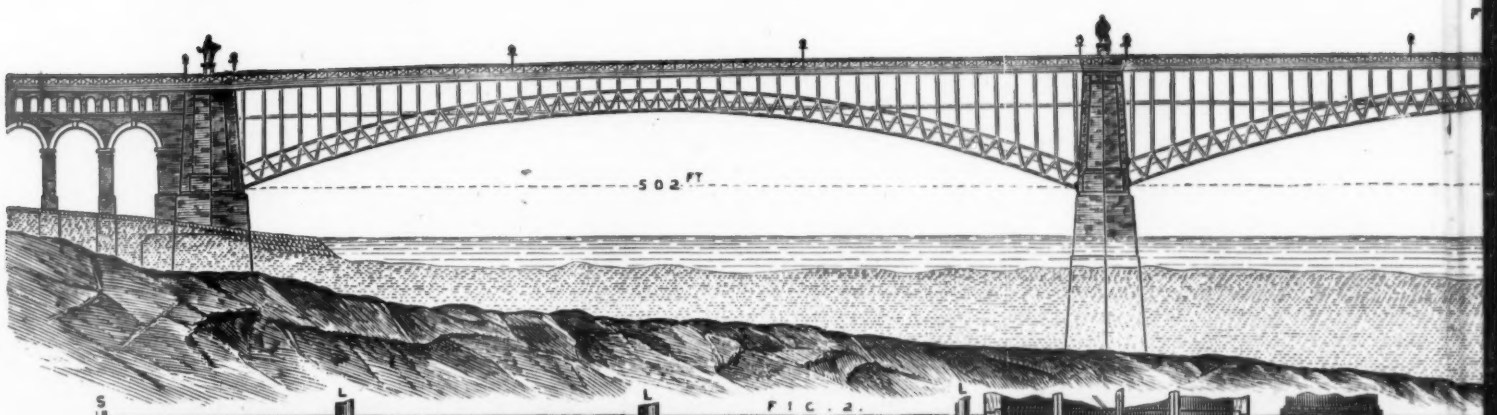


FIG. 2.

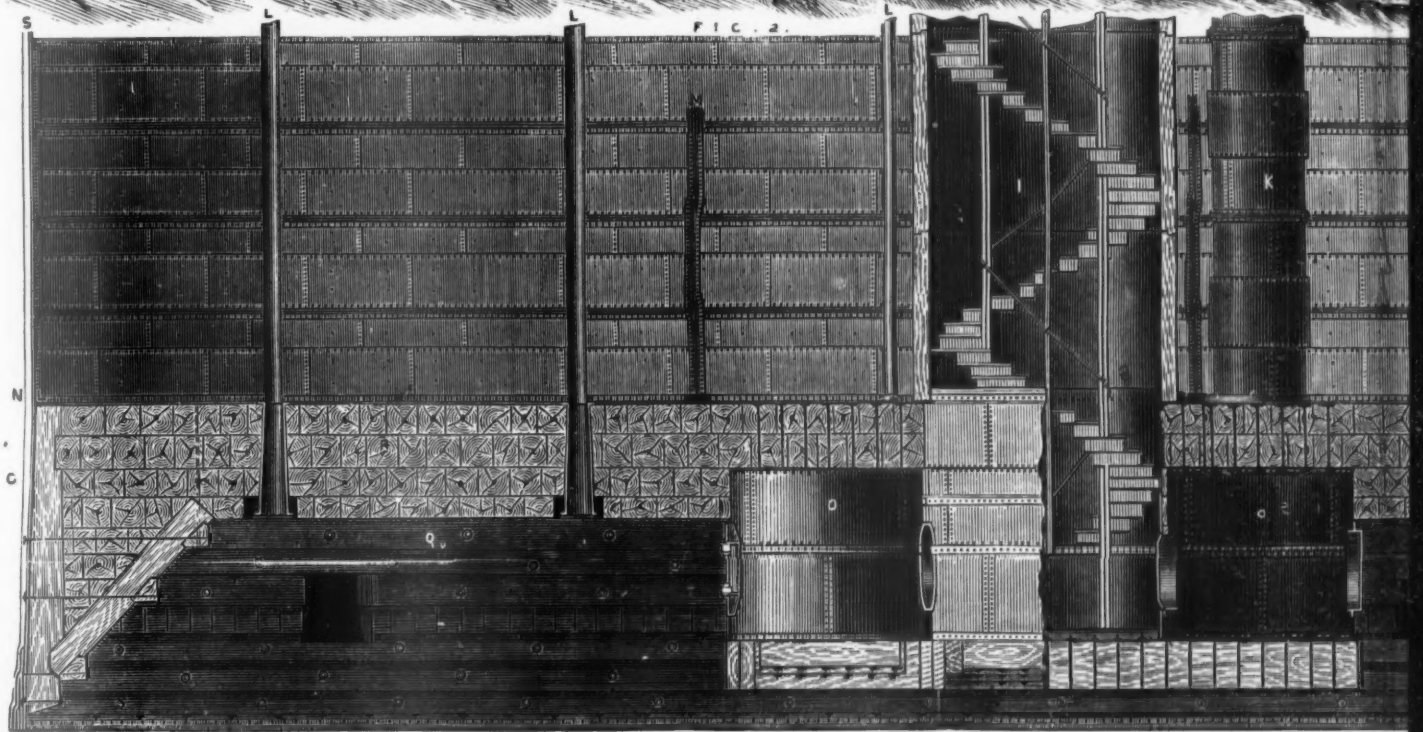
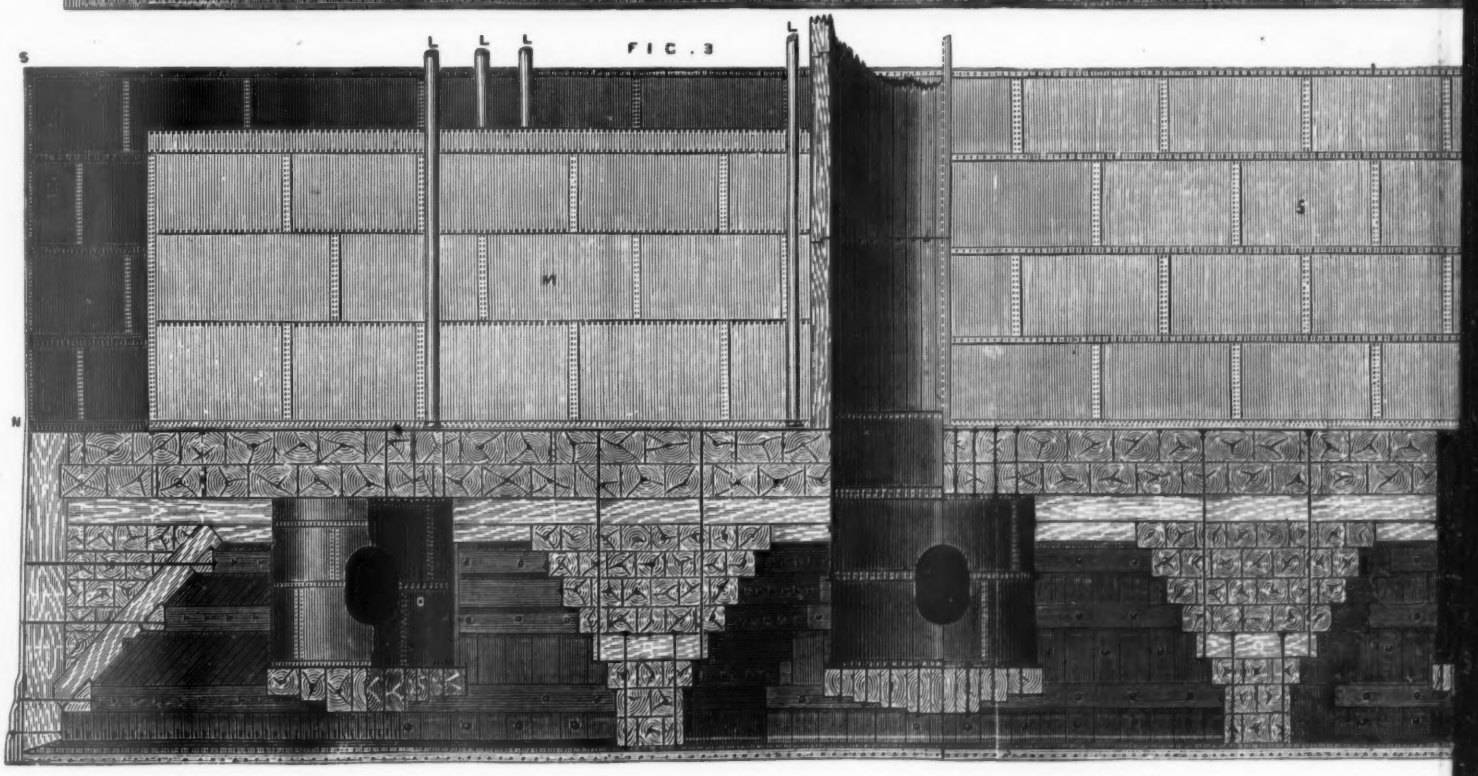


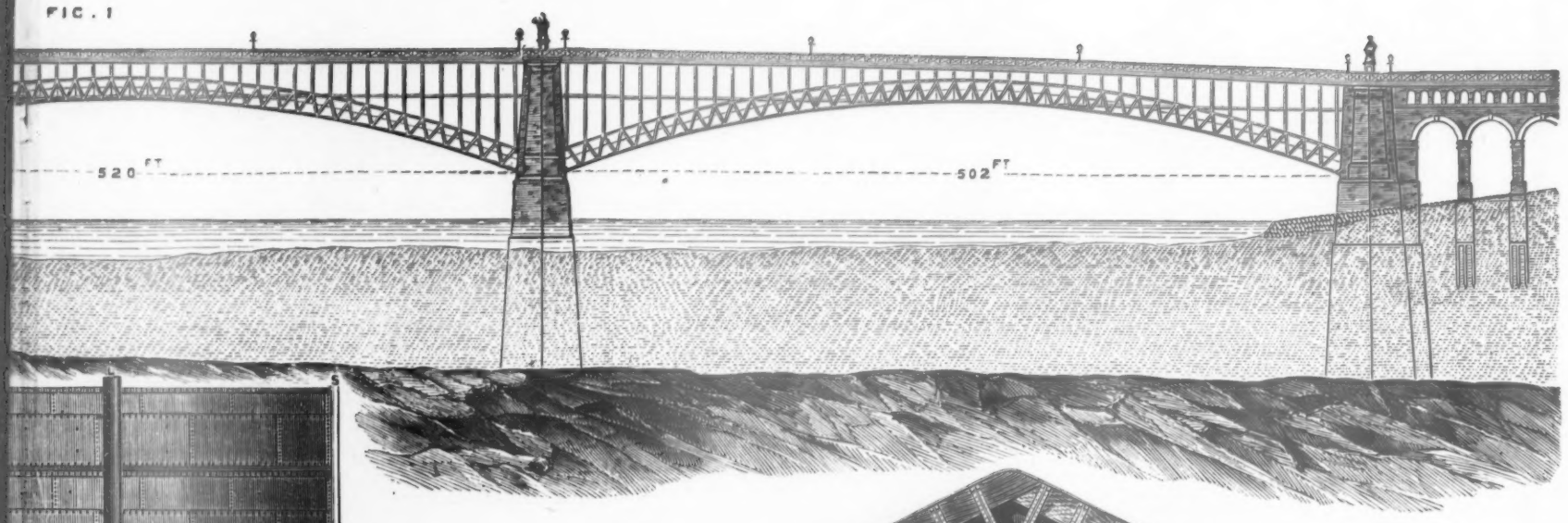
FIG. 3

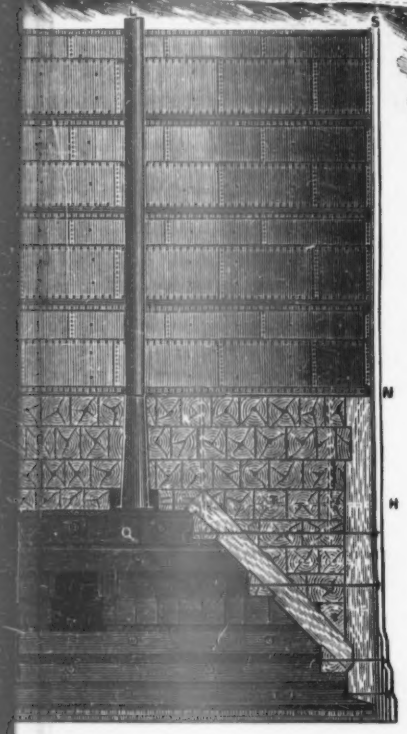


THE ILLINOIS AND ST. LOUIS BRIDGE, OVER THE MISSISSIPPI RIVER, A

JAMES B. EADS, Engineer.

FIG. 1





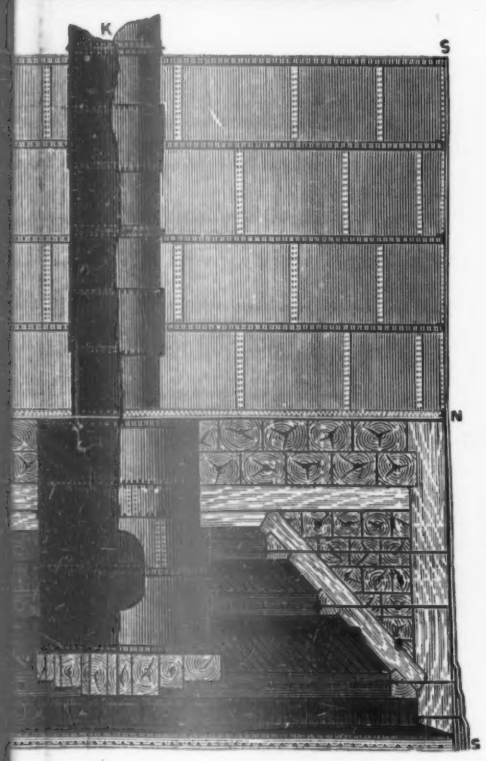


FIG. 4.

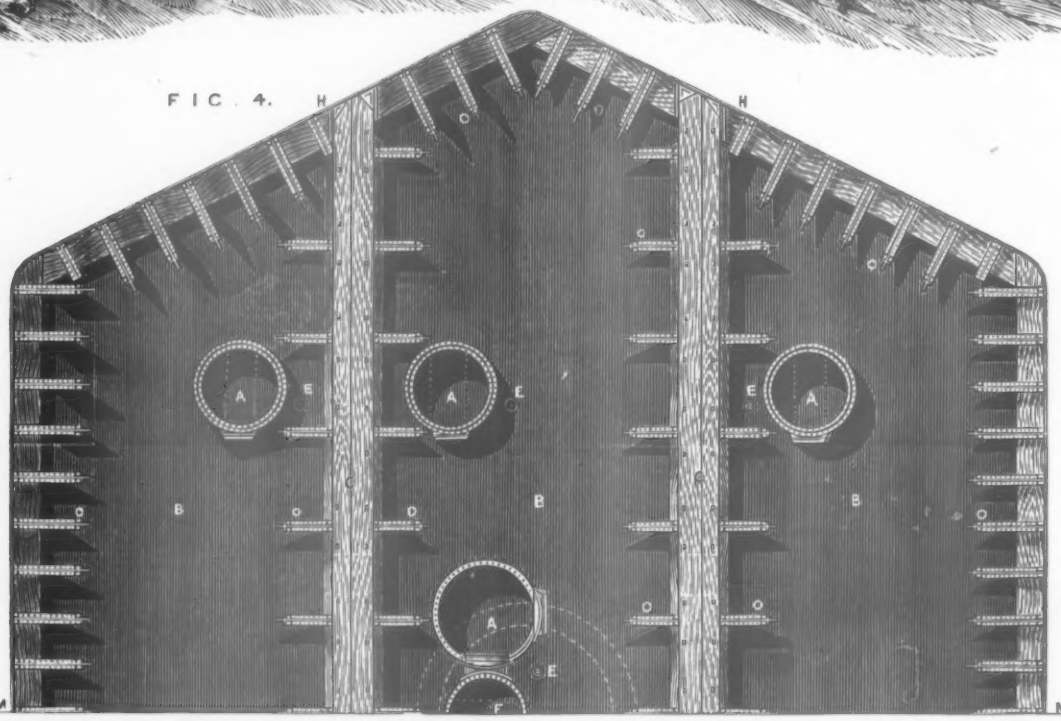
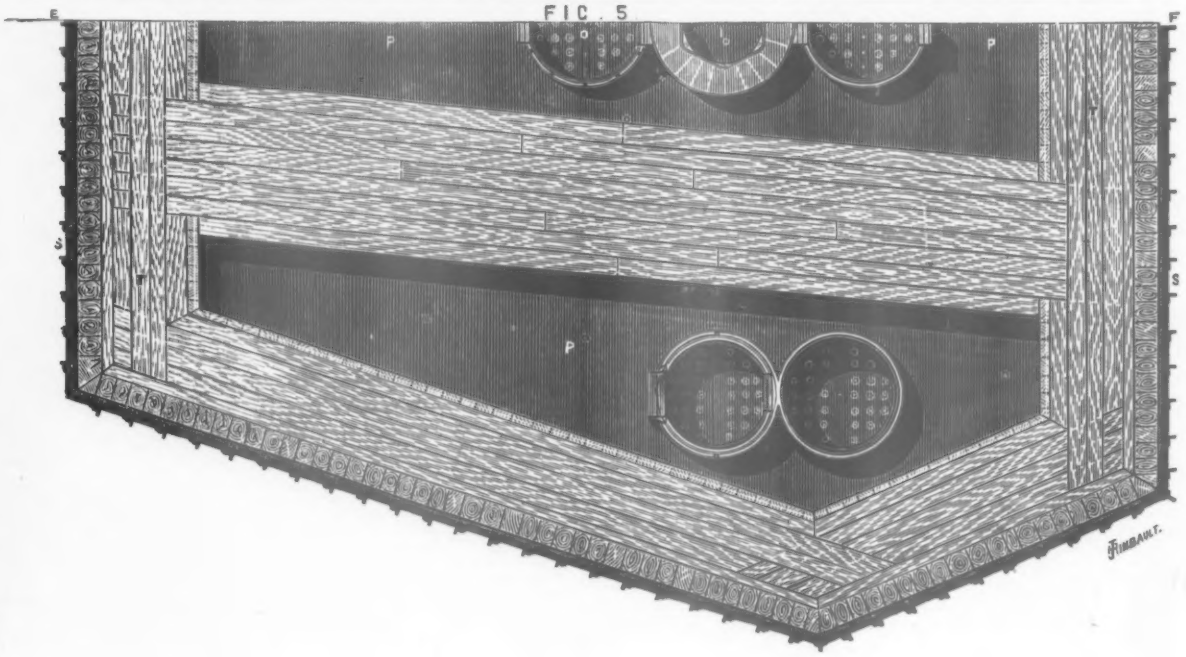


FIG. 5



AT ST. LOUIS, MO.

that of greenish-colored bronze. The effect is very good, and the color has the advantage of not showing dust or dirt.

One of the most highly ornamented and brilliantly colored buildings, however, is one just completed on Bond street, near Broadway. It has a very wide front and is built with heavy columns in imitation of stone. The principal color in the upper portion is drab, and in the lower, dark blue, or lead color. The moldings and window-frames are dark brown, with a little red on some of the narrower lines. Immediately below she capitals of the columns red ornamental figures are painted, and the projections of the ornamental portions of moldings, etc., are gilded. The whole appearance of the building is very—gorgeous is perhaps the best word, although some might say gaudy. There is, of course, very great difference of opinion about it. Some persons think it is in very good taste, while others, who are of a more sober turn of mind, and whose tastes having a leaning toward things of a more sombre appearance, do not like it. Altogether, it is an agreeable change from the staring whiteness of older buildings, and also from the sort of stupid look which drab or buff, without any variety of color, gives a building.

Every day almost—certainly every week—produces a new example in New York of the growing taste for color in buildings. There are some of almost every shade of brown. One in Brooklyn has recently been painted light green, cream-color and white, another on Broadway within a few days appeared in a new coat of claret and brown, and even the staid office of the RAILROAD GAZETTE has bloomed out in a coat of very yellow drab with gilt trimmings.

Judging from the present tendency, the use of cast iron in architecture will bring into general use a much greater variety in the color of buildings. There will naturally be a great deal of bad taste shown in its use, but we cannot help feeling that it will add to the cheerfulness and beauty of our large towns. This is especially desirable since the introduction of steam elevators as they will probably have a tendency to increase the height of buildings in the more crowded parts of all our cities, and thus make the streets look more gloomy by shutting out the light.

Iron, on account of its expense, requires to be used much more scientifically, in order to be economical, than stone or wood. It therefore seems as if it would be necessary for architects to have very much the same kind of knowledge as engineers in order to design iron buildings to the best advantage. It also seems probable that the use of iron would of necessity introduce new styles of architecture adapted to the material. It is somewhat surprising that the increased facilities which iron gives for the admission of light into buildings of great depth, or on narrow streets, has not been more generally recognized. There are also indications that the style of ornament to be used in iron buildings will be entirely different from that of other structures, and that, with greater scientific knowledge, much of the ornamentation which often appears frivolous will disappear.

The great concentration of capital in railroad enterprises will probably cause the erection of very large and expensive buildings for stations, work-shops, etc., so that probably the design of these buildings will be allotted to engineers instead of architects. It is to be hoped that in planning such buildings they will exercise their scientific knowledge more, and their affectation of architectural ornament less, and thus, of necessity, they will be compelled to adopt a new style in their buildings. By doing so, and using color in good taste in painting their buildings, we will have a style of architecture peculiar to the civilization and knowledge of the Nineteenth Century.

THE ILLINOIS RAILROAD LAWS.

To-day the different laws relating to railroads passed by the Illinois Legislature last winter take effect. The chief of these are three—one limiting the charges for carrying passengers, one to prevent "discriminations" in freight charges, and one regulating the relations of railroads to warehouses. By the passenger bill, roads whose gross annual earnings per mile are $10,000 or more are limited to a charge of 2½ cents per mile; those whose earnings are $8,000 per mile to 3 cents; and so on, $4,000 to $8,000 per mile warranting a charge of 4 cents, and less than $4,000 a charge of 5½ cents.

The penalty for the violation of the law is $500 and a "reasonable attorney's fee" to the person overcharged, and, when a judgment shall have been recovered under the act against any company for the fifth time, "such "corporation shall be deemed to have forfeited all its "rights, privileges and franchises; and it shall be the "duty of the State's attorney in any circuit or county "through or into which its road may run, to proceed "against such railroad corporation so violating any "provision of this act, upon information, in the nature "of *quo warranto*, to judgment of ouster and final exe-"cution."

The freight bill prohibits the collection of any charge for transportation for any given distance greater than the charge for a greater distance on the same road; also, the collection of any charge per mile on one portion of a road greater than the charge for any equal distance on another part of the same road. The law also forbids any increase of rates above those charged on the same day and month of 1870, by reason of any decrease which this act requires, and it prohibits, absolutely, any increase of rates above those charged at the same period of the year in 1870.*

The railroad companies of the State, without exception, so far as we know, regard all provisions of these acts limiting their charges as unconstitutional and void. The original contract between each company and the State, as expressed in its charter, expressly granted it the right to fix its own charges for the services it renders. This right, so granted, is believed to be guaranteed by the Constitution of the United States, and to be beyond the power of legislatures and constitutional conventions to abrogate. The companies, of course, taken in the aggregate, have the counsel of hundreds of the ablest lawyers, and if they are prosecuted under the law, as some of them, doubtless, will be, they will go before the courts with the utmost confidence. The decision in such cases will go far to establish the limitations of the power of the Legislature to control corporations.

The warehouse law affects the railroad companies chiefly in the receipt and delivery of grain. The companies have prepared regulations concerning the weighing of grain in compliance with the law.

* Both these laws are given, in full, in the RAILROAD GAZETTE of April 8, 1871.

The Rock Island Report.

We give elsewhere in this number of the RAILROAD GAZETTE the annual report of the President and the most important parts of that of the General Superintendent of the Chicago, Rock Island & Pacific Railroad for the year which closed with last March. The statements of the operations of the year are given so clearly and fully that any elaboration in the way of comment would be superfluous.

Doubtless the recent excitement over Rock Island stock in Wall street will cause this report to be studied with unusual interest, and some will expect to find in it data for determing the value of Rock Island stock. As Wall-street values, and especially Wall-street fluctuations, are very little affected by the productive capacity of properties, perhaps they will be disappointed. If they are acquainted with the location of the road and the country on its line, however, they will readily see that the property is a fine one, whose business is likely to increase materially, year by year, for many years to come, notwithstanding the large number of new railroads lately opened, or soon to be, in Illinois and Iowa, which are sure to affect unfavorably the receipts of some lines. The new road to Leavenworth will give the road access to the growing business of Kansas, but, doubtless, will be chiefly valuable for its local traffic, which is likely to become very large. The whole line is maintained in excellent condition and well equipped. Such a line with a capital account of $45,000 per mile, gross earnings of $10,200 and net earnings of $4,445 per mile, and a land grant which will probably realize $6,000 per mile of road, is certainly a very handsome property.

NEW PUBLICATIONS.

Rand, McNally & Co.'s Western Railway Guide.—Rand, McNally & Co., of Chicago, well known throughout the West—and beyond the West, probably—among railroad men, as printers of cupon tickets, fine colored work, and railroad printing generally, have commenced the publication of a monthly railroad guide. They do not propose to make a guide for the whole country, or a guide for a section of the country differing from the national guides only in extent. That has been usually the plan of local guides, which frequently have been almost worthless; but this publication aims to give a large amount of information which there is no room for in the national guides. It is intended to give time tables of all the lines west of Buffalo and north of Tennessee. We have not examined it sufficiently to find whether its list is complete within those limits, but it sometimes exceeds them giving not only the trunk lines to New York, Philadelphia, Boston, Baltimore, Mobile and New Orleans, but also several local lines in New York, New Jersey and Pennsylvania.

The first peculiarity which will strike the traveler, is that, in connection with each time table, are given short descriptions of all the principal stations on the line—all of any importance, we should rather say; for very few stations are left without notice of some kind. Take the Rock Island road, for instance: Englewood is given four lines, Blue Island, Bremen and Mokena, two each; Joliet twenty, Minooka one, Morris twelve, Seneca two, Marseilles six, Ottawa twenty-two, and so on; usually the population, names of hotels, newspapers, and brief manufactures being noticed. This seems to us an excellent feature, sure to be interesting to the passing traveler, and of permanent value to every man, as it will serve as a gazetteer of the railroad towns of the West.

Another novel feature is a "general index and express directory," which is an alphabetical list of the stations named in the book, with the name of the railroad on which each is situated indicated by letters and the express company running to it indicated by characters.

Another valuable feature is a schedule of steamboat lines on rivers, which are often quite as important as railroads, but which are not given in ordinary guides. The chief landings on the Ohio, Mississippi, Missouri and Illinois are described and distances given.

A table is given which shows the difference in time of different localities, in which one may see at a glance and without stopping to make a calculation the amount in minutes and seconds that the time of any one of the 88 places mentioned is faster or slower than the time of either New York, Buffalo, Cincinnati, Chicago or St. Louis.

A map accompanies the guide which shows the country from Oswego, N. Y., in the East, to Lincoln, Neb., in the West, and from Mackinaw in the North to Memphis in the South. It is a section of Watson's well-known railroad map, and is, perhaps, as accurate as such maps usually are, but it needs revision and is besides so crowded as to be confused.

The form of this guide is similar to that of *Appleton's*, and it is quite as large, having 288 pages, of which only 24 are devoted to advertisements. It is exceedingly well printed and in this respect may challenge comparison with any other publication of the kind.

Altogether, we have here an example of a truly valuable Western guide, which fills a place not heretofore occupied, and which is so useful that it is likely to be well and permanently supported.

Five Hundred and Seven Mechanical Movements.—This is the explicit title of a handsome square octavo volume of 122 pages by Mr. Henry T. Brown, Editor of the *American Artisan*, and published by Brown, Coombs & Co., publishers of the *Artisan*. One half of these pages are covered with engravings, and the description of each movement is always given on the page opposite to the engraving of it, so that it can readily be referred to. The great variety of the movements given enables the mechanic and the inventor who wish to effect any known result by machinery to find here usually several methods by which it may be done, and thus select that best suited to the circumstances of the case. It serves as a dictionary of mechanical movements, in which, by means of the index, the untechnical reader is able to find an explanation of processes which otherwise might be altogether unintelligible to him. For instance, the said untechnical reader, not knowing, but wishing to know something about the regulator of his watch, finds in the index "Regulator, watch, 318." Turning to section 318, he finds a description of the watch regulator, and on the opposite page an engraving of it; or he hears some one speak of a "toggle joint," and looking up "toggle joint" in this book, he finds it visibly presented; that interesting but now almost obsolete institution, the tread-mill, engages his attention, and the book tells him and shows him what it was and how it looked; having been told that such and such an instrument is furnished with a micrometer screw, he turns to paragraph 111 in *Five Hundred and Seven Mechanical Movements*, and immediately knows what a micrometer screw is. So we see that the book is worthy of a place as a work of reference in every library, and, besides its value to mechanics, will serve to explain many things which would otherwise be unintelligible to the general reader. It is a good book to put by the side of the dictionary in the library, as well as on the shelf in the shops.

The Railways of Canada.—This volume assumes to do for the railroads of Canada something like what Mr. Poor's invaluable "Manual" does for the railroads of the United States; but as Canada is very much smaller than the Union, and the book not so much smaller than Mr. Poor's, the authors have had much more room for each road. This additional room has, in most cases, been used to give a history of each road, often quite in detail and very interesting. This is information often of the highest value, and which cannot be obtained concerning most American railroads except with great difficulty and considerable research.

The statistics in the book under consideration are sometimes very full and complete, showing the condition of a road and its operations for each of a long series of years; but they are hardly systematic and uniform enough to be of the highest value. In a book of reference we wish to be able to know just where to find what we want. A compact statement of the length, direction and termini of a line and its branches, with the addresses of its officers, *given together* for each road, at the beginning or end of the article concerning that road, adds greatly to the practical value of a manual of this kind.

The book is a valuable one, however, for very many purposes. It seems to have been very carefully edited, and it must be indispensable to Canada railroad men and to those who have much to do with them and with their roads.

The book is edited by J. M. and Edward Trout, and published in Toronto, at the office of the *Monetary Times*, a very excellent commercial and financial paper, published, we believe, by the Messrs. Trout.

The American Railway Official's Manual.—In his preface the compiler of this volume says that his purpose was "to collect those tables and such data as must be referred to "most frequently, and to preserve in an accessible form papers and "articles of a theoretical or practical value which seemed to be of "permanent value." The contents are such as are of special value to the engineer, and especially to the mechanical engineer. For instance, it has tables of the circumference and areas of circles from 1-32 to 100 ¾ inches in diameter, giving all diameters down to eighths of inches; a table of weights per foot of flat iron, of breadths from one to six inches, and of thickness from ⅛ to one inch, increasing by eighths; also of square and round bars from ⅛ inch, side or diameter, increasing by eighths to six inches, with the formula for converting these weights of iron into weights of cast iron, steel, copper, brass, lead and zinc for similar sizes; weights of angle iron, washers, hot and cold-pressed nuts, wire and bolts; tables of screws, and standard screw threads (such as were recommended bp the late Car-Builders' Convention); a table of the properties of metals—showing weight, specific gravity, tenacity, crushing force, melting point, expansion between 32° and 212°, conducting power and specific heat; tables of weights and measures, including one much needed of the French decimal system with the different units reduced to the English standard; Kirkaldy's experiments with iron and steel; an abstract of Fairbairn's experiments;

articles on the strength of columns and beams, the laws of friction, adhesion of leather belts to cast-iron pulleys, limes, mortars and cements and valve-gear; rules for testing boilers, for shrinking on steel tires, for the strength of boilers, testing rails; excavation and embankment tables etc. It has also a directory of the superintendents, master mechanics, master car-builders and purchasing agents of the railroads of North America. The matter seems well selected, and nearly all of it is of permanent value, and worthy of perservation. Indeed, much of it, as is evident from the summary of the contents we have given, is such as must be frequently referred to by those who design and construct rolling stock and machinery. The form of the book is peculiar, the pages being 9 inches high by 12 wide, and though this is not the most convenient form for handling, it gives opportunity to present the tables very clearly, and, we may say, for a large number of large advertisements in exceedingly large type—many of them almost large enough for posters.

The book is most elegantly printed on fine paper, and is handsomely bound. It is not published for sale, but is distributed free among certain classes of railroad officers, the advertisements being depended upon for the remuneration of the publisher Works published in this way are not uncommon, and some of them are not without value. But we know of no other of this character, or which is so likely to be valued by mechanical engineers, and certainly we have seen none which can be compared with it in elegance; indeed, few works published are so favorable examples of fine book-making.

The book is published by Coyne & Relyea, Nos. 108 and 110 Randolph street, Chicago.

Illustrirte Deutsch-Amerikanische Gewerbe und Industrie Zeitung.—This is the title of a weekly periodical in the German language by Hoffman & Mowitz, in Philadelphia, and edited by A. Daul. It contains descriptions and engravings of machinery, etc., a list of patents issued, and—a peculiar and interesting feature—a summary of the contents of all the American technical journals, which, so far as we have been able to examine it, has been very carefully done.

This is said to be the only technical journal in the German language published in the United States.

ELECTIONS AND APPOINTMENTS.

—We understand that Mr. Augustus Newman, for many years General Passenger Agent of the Chicago & Alton Railroad Company, has offered his resignation, to take effect on the appointment of his successor.

—J. W. Conlogue has resigned his position as Superintendent of the Vandalia Division of the St. Louis, Vandalia, Terre Haute & Indianapolis Railroad.

—Mr. James Charlton, late General Agent of the Great Western Railway, of Canada, and for a year or more past General Ticket Agent of the North Missouri Railroad, has, it is reported, been offered the position of General Passenger Agent of the Chicago & Alton Railroad, and is likely to accept it. Mr. Charlton is a gentleman of rare ability and accomplishments, and his experience on the North Missouri has given him a thorough knowledge of the special field in which the Chicago & Alton will soon be working more actively than ever.

—Mr. T. P. Edwards has resigned his offices as Secretary of the Central Railroad Construction Company, of Iowa, and also of the New York Western Railway, and changed his residence from Cedar Rapids, Iowa, to Sterling, Ill.

—Mr. B. K. Verbryck has been appointed Master of Car Repairs of the Chicago, Rock Island & Pacific Railroad, in place of J. I. Fogg, resigned.

—At an annual meeting of the stockholders of the Chicago, Burlington & Quincy Railroad Company, held in Chicago, June 28, 1871, the following stockholders were elected directors for the ensuing year: Erastus Corning, of Albany, New York.; John C. Green, of New York; Sidney Bartlett, John W. Brooks, John A. Burnham, John N. Denison, John M. Forbes, Nathaniel Thayer and Robert S. Watson, of Boston, Mass.; James F. Joy, of Detroit, Mich.; Chauncey S. Colton, of Galesburg, Ill., and James M. Walker, of Chicago. All these, except Messrs. Burnham and Walker, were members of the board chosen a year ago. Mr. Burnham has been in the board for some months, having been chosen by the directors to succeed William Boott, of Boston, resigned, and Mr. Walker is an additional member, it having been decided at the late election to have twelve directors instead of eleven, as heretofore. Mr. Walker has long been Attorney of the company, and is President of the Leavenworth, Lawrence & Galveston Company. The directors will elect officers in Boston next week.

—C. E. Follett, long General Ticket Agent of the Ohio & Mississippi Railroad, has accepted an appointment as General Ticket Agent of the St. Louis, Vandalia, Terre Haute & Indianapolis Railroad, in place of France Chandler, resigned.

—At a late meeting of stockholders of the Southern Minnesota Railroad Company the following directors were elected: Clark W. Thompson, Wells, Minn.; T. B. Stoddard, C. G. Wykoff, La Crosse, Wis.; Henry W. Holley, Winnebago City, Minn.; Charles Bard, Norwich, Conn.; Augustus Armstrong, Albert Lea, Minn.; M. K. Jesup, A. P. Mann and P. M. Myers, New York. This is the same as last year's directory. The officers, elected last week, are Clark W. Thompson, of Wells, President; P. M. Myers, New York, Vice President; B. G. Lennox, La Crosse, Secretary; C. G. Wykoff, Treasurer. Wykoff was appointed General Manager.

—James Ellison, late Train Dispatcher of the Fort Wayne road, has been appointed Superintendent of the Indianapolis & Vincennes line of the Pittsburgh, Cincinnati & St. Louis Railway, in place of D. C. Branham, resigned.

—The directors of the Keokuk & Hamilton Bridge Company, on the 20th ult., chose Andrew Carnegie, of Pittsburgh, President, and William Leighton, of Keokuk, Vice-President.

—Gen. John C. Breckinridge, F. K. Hunt, of Fayette County, and Judge Simpson, of Clark County, have been elected the Kentucky directors of the Lexington & Big Sandy Railroad Company. The other six directors are New York parties interested in the Chesapeake & Ohio Railroad.

—Charles R. Peddle has resigned the General Superintendency of the Vandalia Railroad, in consequence of ill-health, to accept a less laborious position on the same road, and Major John E. Simpson, Assistant Superintendent, has been appointed to the General Superintendency.

—Mr. Edward P. North, who was connected with the Union Pacific Railroad during its construction and had charge of some important tunneling operations on that line, has been appointed General Superintendent of the Great Northern Railroad of Texas.

—B. F. James, late Assistant Treasurer of the Burlington & Missouri River Railroad Company, has been appointed Superintendent of the Detroit, Hillsdale & Indiana Railroad, now in operation from Ypsilanti to Hillsdale.

—It is reported that A. B. Coon, of Marengo, a lawyer and politician pretty well known in his Congressional district, hopes for an appointment as one of the State Railroad Commissioners. It is also said that an effort will be made to secure the appointment of John Van Nortwick, of Batavia, who is an engineer of ability and respectability, a man of independent fortune, and was for some years Superintendent of the Chicago, Burlington & Quincy Railroad. Mr. D. S. Hammond, a farmer and politician of Cook County, is also spoken of for the place.

—The Frankfort, Paris & Big Sandy Railroad Company organized at Paris, Ky., on the 6th ult., by the choice of the following directors: B. F. Pulley, B. F. Rogers and Gen. J. T. Croxton, of Bourbon County; Col. B. Stoddard Johnson and E. H. Taylor, Jr., of Franklin County; Capt. J. E. Cantrell, Noah Spears and Alexander Thomas, of Scott County; Dr. E. D. Standeford, of Louisville; W. S. Richart, of Montgomery County, and J. S. Richart, of Bath County.

—At a meeting of the stockholders of the Michigan Central Railroad, held at Detroit on June 26, the following gentlemen were elected directors for the ensuing year: James F. Joy, of Detroit; J. W. Brooks, Nathaniel Thayer, Sidney Bartlett and H. H. Hunnewell, of Boston; Erastus Corning, of Albany; and George F. Talman, Moses Taylor and John Jacob Astor, of New York. All these are re-elected. The officers, also re-elected, are: James F. Joy, President; Nathaniel Thayer, Vice President; Isaac Livermore, Boston, Treasurer; H. E. Sargent, Chicago, Superintendent; William Boott, Boston, Auditor; Joshua Crane, Boston, Clerk.

MECHANICS AND ENGINEERING.

British Rail Exports for May and for Five Months.

Heyerdahl, Schoenberg & Co. give the following report of exports of railroad iron from Great Britain, extracted from government returns:

	Month ending May 31.			*Five months ending May 31.*		
	1869. *Tons.*	1870. *Tons.*	1871. *Tons.*	1869. *Tons.*	1870. *Tons.*	1871. *Tons.*
United States	25,557	33,175	64,144	141,634	150,980	199,865
Russia	23,120	52,741	19,466	52,714	77,466	34,198
Austrian Territories	1,875	2,039	1,264	12,975	15,102	1,873
British India	11,727	13,411	3,362	30,132	87,092	25,034
British North America	4,789	3,450	6,077	12,992	12,154	14,713
Egypt	1,545	43	17	3,711	1,564	463
Australia	2,799	212	1,005	9,961	4,629	8,922
Brazil	9	337	2,252	584	2,270	8,489
Holland	1,584	2,821	2,183	4,880	10,556	3,871
Spain and Canaries	1,282	670	1,446	5,673	7,998	4,859
Sweden	10	992	914	2,890	992	2,127
Chili	12	59	1,411	1,070	5,763	2,320
Spanish West India Islands	....	200	....	319	1,811	533
Peru	886	3,483	2,200	9,306	6,345	7,73.
France	485	17	....	2,770	163	1,030
Germany	2,277	10,829	8,547	4,033	25,128	28,711
Other countries	9,435	6,799	6,409	24,597	27,219	28,394
Total	87,394	131,208	120,997	320,745	437,235	373,139
Total exports from Great Britain of iron and steel to all countries	253,129	317,725	350,786	1,001,714	1,162,519	1,126,32

The Hinkley & Williams' Works, of Boston.

Those who know this establishment only by the engines built there when the firm was Hinkley & Drury, have no idea of the kind of work which is done there now. The design of the locomotives which are turned out there now is entirely different from that of former days. The shops have been supplied with the latest improvements in tools and machinery for doing work in the best manner.

Mr. H. L. Leach is Superintendent, and Mr. Frank D. Child, Chief Draftsman. Together they supply what is needed in every locomotive and machine shop, *i. e.*, the skill to plan and the ability to execute. The more recent work of this establishment shows that it has been designed with that sort of mechanical instinct which resembles so much, if it be not identical with, the "art faculty." Work of this kind is not highly ornamented, but there is about it a sort of refined adaptation of means and ends. There is no sacrifice of utility for ornament, but every part is so proportioned and arranged as to do the very best thing in the very best way, and in doing so it assumes a beauty of its own which is often not aimed at when the work is designed.

Having said this much, we must also add, that the merit of the Hinkley locomotives is not in their appearance only. They have been steadily growing in favor and have long been noted for good boilers, which are not surpassed, if equaled, by those made any where else in the country.

In these shops 375 men are employed and are at work in the following orders: 8 mogul engines for the Chicago, Danville & Vincennes Railroad; 2 four-wheeled switching engines for the New York Central; 1 eight-wheeled engine, 16x21 in. cylinder, for the Fort Wayne, Jackson & Saginaw; 5 of the same class for the Chicago & Iowa, and 4 for the Burlington, Cedar Rapids & Minnesota.

Delaware Car Works.

Messrs. Jackson & Sharp, at their works in Wilmington, Del., are constructing two first-class, two second-class and two express and baggage cars for the Denver & Rio Grande Railway; one passenger car and one baggage for the Central Valley Railroad, of New Jersey—all narrow-gauge stock.

It has lately completed two palace cars for the Pullman Southern Car Company, will ship two more this month, and three more early in July. They are to run between Louisville and New Orleans.

The firm has lately completed an addition, 249 feet long, to their erecting shops, making that building 490 feet by 70, and capable of containing thirty-two cars. Early in June the Western Union Telegraph Company connected with the office of these shops, so that it may be reached directly from all parts of the Union.

Transportation of Cars and Locomotives.

One of the indications of the rapid growth of railroads in this country is the establishment of a special business for the transportation of cars and locomotives. As these vehicles require no care for their carriage, there is no "dead weight," and a special tariff is made, usually, we understand, of so many cents per mile. Mr. E. Simmonds, formerly connected with the Union Pacific during its construction, has established a "locomotive and car express," and executes orders for the transportation of cars and engines from the manufactories to the roads where they are to be used, in charge of messengers who take care of them on the way. In order to be able to move narrow-gauge engines from Paterson over the Erie Railway, Mr. Simmonds has provided broad-gauge trucks, on which the locomotives are placed until they reach roads of standard gauge, when they are run on their own wheels.

Bellaire Bridge.

This bridge over the Ohio River between Bellaire and Benwood—4 miles south of Wheeling—which connects the main stem of the Baltimore & Ohio Railroad with its Central Ohio Division, and which has been in course of construction for the past two years, was completed last week.

The bridge is nearly three-fourths of a mile in length. The channel-span is three hundred and fifty feet long, ninety-five feet above low-water mark and contains six hundred tons of iron.

The approach on the Ohio side is made by an arcade consisting of forty-one arches, forty feet from center to center, and is pronounced by competent judges to be the finest piece of masonry in the country. It is proposed, we understand, to open the bridge formally on the 4th of July.

The Keokuk Bridge.

A report has been widely spread that the railroads having termini at Keokuk refused to use the new bridge recently completed at that point, on account of some difficulty with the Bridge Company *vs.* The City. It is true that there was some delay after its completion, before satisfactory arrangements could be made; but all difficulties were soon settled and on the 20th inst. trains of the Toledo, Wabash & Western and the Toledo, Peoria & Warsaw roads commenced crossing regularly.

MISCELLANEOUS.

—The following contracts for the transportation of Indian supplies were awarded by the Indian Bureau on the 23d ult.: To Chick, Browne & Co., of Kit Carson, from Kit Carson, Cal., to Fort Defiance and Wingate, Los Pinos Agency, $1 per 100 pounds per 100 miles; John H. Coad, Omaha, from Fort D. A. Russell to Red Cloud Agency, $1.45 per 100 pounds per 100 miles; D. J. McCann, Nebraska City, from Fort D. A. Russell to Whetstone Agency, $1.75 per 100 pounds per 100 miles.

—The question whether narrow-gauge railroads are first-class railroads within the meaning of the law, is likely to arise soon in the Interior Department on account of some companies which have obtained land grants desiring to build narrow instead of ordinary-gauge roads, if the grants can be secured by them. The quality of a road depends more upon the character of its construction, and the amount of its rolling stock, than upon its gauge; though, doubtless, the "railroads" meant in the acts granting land were roads of standard gauge, and not anything which will bear some sort of a car.

—A New Jersey decision makes railroad companies responsible for local improvements, paving, grading, etc., in cities, notwithstanding the usual stipulation of railroad charters that the tax of one-half of one per cent. per annum paid into the State Treasury should be in lieu of all other assessments to be imposed upon them.

St. Louis Union Depot.

An adjourned meeting of St. Louis railroad men, to discuss the project of building a union railroad depot in that city, was held on the 27th inst., and resolutions were adopted stating that difficulties had been developed that can only be overcome by the friendly action of the city in changing the grades of streets and vacating some for short distances, and perhaps the modification of the general law under which depot corporations are created. This being the case, a committee was appointed to confer with the city authorities and officers of the several railroads terminating on this side of the river, and ascertain whether such facilities and united action can be had.

General Railroad News.

CHICAGO RAILROAD NEWS.

Lake Shore & Michigan Southern.

This company this spring commenced tree-planting on a considerable scale, 11,000 chestnuts and 10,000 European larches having been planted along its line between White Pigeon and Toledo, through the country where the forests have been mostly cleared away and the supply of timber is scantiest. The trees were of one year's growth and were planted on each side of the track, 50 feet apart, the tree on one side being opposite the middle of the space between two trees on the other. For each tree a hole was prepared 2½ to 3 feet in diameter, the earth being well spaded up and the top soil thrown to the bottom. The trees were carefully set out, mulched and a stake provided for each. The work was most thoroughly done, with intention that every tree might live, and the cost including the time of the laborers, who belonged to the regular force of the road and did this work in connection with and in addition to their ordinary duties, was an average of 8 cents per tree; excluding the labor of the company's ordinary employes the cost was only 4 cents per tree.

The results of these experiments will be watched with great interest. There is hardly room to doubt that railroad companies, especially in treeless regions, may very easily increase the value of their property by such measures.

Lake Superior Excursion.

The Chicago & Northwestern Company are sellin g round trip tickets to the Lake Superior country at $35.25, a little less than 60 per cent. of the usual fares. The route given is from Chicago to Green Bay, Escanaba, Marquette, Duluth, St. Paul, and from there by way of Madison, Milwaukee or the river steamers and Freeport back to Chicago. This order of travel may be reversed, enabling the excursionist to leave by way of St. Paul and return by way of Green Bay.

Chicago & Northwestern.

The company has purchased ground for its station in Madison, Wis., in East Madison, near the gas works, and has under contract the passenger and freight houses, each about 80 by 30 feet, which will be completed at an early day.

Pittsburgh, Fort Wayne & Chicago.

This company has recently completed a new iron viaduct in place of a wooden structure on Randolph street over their track near the Chicago River. It is the work of the Keystone Bridge Company.

Chicago & Alton.

The construction company's line from Roodhouse to Louisiana has been delayed somewhat, and the new Chicago line from Chicago to Kansas City *via* Louisiana and Mexico, will hardly be opened before the 1st of September.

Mr. A. Newman, the General Passenger Agent of this road has tendered his resignation, to take effect on the appointment of his successor. Mr. Newman has occupied this office for many years, and has been a most faithful, earnest and devoted servant of the company, whose passenger business has thriven excellently during his administration.

The receipts of the road for the third week of June were:

1871 511 miles)	$121 823.55
1870 (451 miles)	107,984.29
Increase (12½ per cent.)	$ 13,839.26

Chicago, Rock Island & Pacific.

The second track of this road between Aux Sable and Morris, about five miles, has been completed and was put into use on the 29th ult. We give elsewhere the annual report of the company for the year ending March 31.

The extension of the Chicago & Southwestern from Princeton to Trenton, 25 miles, was to be ready for delivery to this company to-day. The work of grading the last remaining section of this road, from Trenton Southwest to Cameron, 43 miles, was commenced last Wednesday. It is expected that it will be completed early in August and that trains will commence running between Chicago and Leavenworth by this route about the 1st of September.

Chicago, Burlington & Quincy.

The company has recently received two new locomotives from the Baldwin Works, numbered 176 and 177, and two from the Manchester Works, numbered 178 and 179. At the annual meeting held at the office in this city on Wednesday last, the old board was re-elected, the number of Directors increased from eleven to twelve, and J. M. Walker, of Chicago, was chosen to fill the place thus created.

OLD AND NEW ROADS.

Central Branch Union Pacific.

A telegram from Washington dated the 23d ult. says: "Before leaving the city, Attorney-General Ackerman rendered his opinion to Secretary Delano adverse to the petition of the Atchinson (or Pomeroy) Branch Pacific Railroad, then pending in the Interior Department, for the issue of lands and bonds upon the extension of its road to the hundredth meridian. Agents and counsel of the company have been busily engaged, since the opinion was finished, in trying to induce Ackerman to recall it. The claim is the same which this company has been pressing here for five years, alternately, before Congress and the Interior Department, by both of which it has been repeatedly rejected."

European & North American.

The Philadelphia *Age*, in speaking of this road having said that "the stock is about equally divided between "the two countries; the American stockholders are "mostly residents of the State of Maine, and their por- "tion of the work has been the construction of the road "from Bangor to Vanceboro', on the St. Croix River," a writer in the Columbia (Pa.) *Herald*, evidently having authorative information, says:

"The statement made by this writer that 'the stock is about equally divided between the two countries,' is made in error. Nor are the American stockholders 'mostly residents of the State of Maine.' It is true that authority to build the road from Bangor, Maine, to St. Johns, New Brunswick—a line some two hundred and four miles in length—was originally vested in the stockholders resident in Maine, but the majority or weight of stock is not there held. The fact is that the following gentlemen are justly entitled to the credit of pushing forward this important enterprise, and they should in justice, have it: Benjamin E. Smith, Hon. William Dennison, Messrs. B. S. & W. C. Brown and James McKee, of Columbus, Ohio; William G. Case and Robert Crane, of Columbia, Pa.; J. Edgar Thompson, B. B. Thomas, J. J. Thomas and W. H. Bradley, of Philadelphia; J. J. Sanderson, of Jersey Shore, Pa.; H. C. Lord, of Cincinnati, Ohio; J. F. Seely and Samuel F. Parson, of New York; Jarvis Williams, Adams Ayer and James W. Emery, of Boston, Mass; G. K. Jewett and Noah Woods, of Bangor, Me.; E. W. Williams, of Saco, Me.; E. R. Burpee, of St. Johns, New Brunswick, and Gilead A Smith, of London, England.

"These gentlemen formed the corporation, and bound themselves to the task of completing the road between the points named, and received in payment therefor what the two companies had to give, chiefly stocks and bonds. We say, then, that to these men belongs the credit of the new and important enterprise alluded to, and in which they now have a controlling interest.

"The Columbia Steel and Iron Company, of Columbia, Pennsylvania, of which William G. Case, Benjamin E. Smith and William Dennison are proprietors, is now engaged in making the remainder of the iron necessary to complete the track in Maine, and it is confidently hoped and expected that the entire road will be ready and opened for business on or before the first of July of this year."

Northern Pacific.

The *Beacon*, published at Kalama, Washington Territory, the Columbia River terminus of the Northern Pacific, gives as reasons for the selection of that point (which is about 35 miles below and nearly north of Portland) for a terminus, because it is below the ice line on the Columbia, has a depth of channel equal to that over the bar at the mouth of the river, is conveniently located for a connection with the fertile Willamette Valley, and is where the river can be conveniently bridged, there being two islands in the channel there. It says that the Columbia River & Willamette Railroad Company is organized in the interests of the Northern Pacific, and is authorized to construct a railroad from a point opposite Kalama nearly due south through Salem to Eugene, on the west side of the Willamette.

From the same journal we learn that the Northern Pacific has commenced the erection at that place of a temporary engine house and machine shop, 100x35 feet; two stalls for engines, 70 feet; a work-shop, 30 feet; and a blacksmith shop, 20x30 feet. These buildings are to be constructed without delay.

Boston, Hartford & Erie.

The Master's report upon the conditions by which this railroad should be transferred by the Receivers to the Trustees was made in the Massachusetts Supreme Court on June 24. They are that the Trustees should be paid $148,533, and the other parties to the suit $16,543—the Trustees to give bonds in $60,000. The report on the condition of the road was more favorable than was expected.

Pennsylvania Railroad.

The telegraph reports that J. Edgar Thomson, President of the Pennsylvania Railroad Company, was in Pittsburgh several days last week, consulting with the authorities relative to a place for bridging and tunneling all street crossings intersecting the company's track in the city limits, some five miles in length. A proposition has been submitted by the company agreeing to build all bridges, and the superstructure of tunnels at its own cost. The city, by way of compensation, is asked to vacate Grant street, from Seventh to Liberty, and one or two squares of other streets in the vicinity of the Union Depot. If the proposition is accepted by the city, work will be commenced at once, and large sums expended in the improvements. To carry out the plan will require the construction of ten or twelve iron bridges and tunnels. The ground proposed to be vacated is located in the heart of the city, and is very valuable.

Port Huron & Lake Michigan.

This road was opened to Lapeer, 43 miles from Port Huron and 36 miles from the late terminus at Attica, on the 6th ult. It is to be completed to Flint, 21 miles further, by September, and to its terminus at Owasso, 25 miles west of Flint, by the end of the year.

Elizabethtown & Paducah.

This company has now 56 miles in operation, from Elizabethtown (42 miles south of Louisville on the Louisville & Nashville Railroad) westward to Horse Creek.

A Railroad Race.

The town of Sullivan, in Moultrie County, Ill., has offered $30,000 to the railroad company which shall first complete a railroad to that place. The result is described as follows by the Mattoon *Journal:*

"A novel race is being run on the Grand Prairie now. It is one between the track-layers of the Bloomington & Ohio River Railroad and those of the Chicago & Illinois Southern, to Sullivan, for $30,000. A heavy force on the former road is slapping the iron down on the prairie sod, from Bement, on the Great Western road, while the contractors, Messrs. Tuttle, Keyes & Co., on the Chicago & Illinois Southern, between our city and Sullivan, have about a thousand men grading, bridging, and stringing down the continuous rail. The force late at work for the company, south of our city, has been replaced on the work on the Sullivan end, and orders telegraphed to the south end of the line for a massing of all the forces at our city immediately. So if Mr. Craddock, the pushing President of the Bloomington road, gets the $30,000, he must do some tall scratching.

"In the meantime, if you want to see dirt fly on a grand scale, go out toward Sullivan."

Burlington & Missouri River.

A new section of the Nebraska line of this road has been opened from Lincoln southwest 18 miles to Crete, on the Big Blue River. The route thence to Kearney will be nearly due west.

Fort Scott, New Chicago & Fredonia.

A contract has been closed for the construction of the Western Division of this new Kansas project, from New Chicago, the junction of the Leavenworth, Lawrence & Galveston Railroad with the Missouri, Kansas & Texas, eight miles south of Humboldt, west by south to Fredonia, Wilson County, 23 miles, to be constructed by November, and to be extended to the Arkansas River, about 70 miles further, a year later.

Atchison & Nebraska.

It is officially announced that the Atchison & Nebraska Railroad will be completed and in operation to Falls City, Neb., by July 10, and to Humboldt, twenty-four miles beyond, by October.

Missouri, Kansas & Texas.

A correspondent of the Missouri *Republican* give the following description of the proposed lines of this road in Texas: "It enters the State at Preston on Red River, in Grayson County, passes down near the Texas Central to the corner of Kaufman County, where it forks, sending one limb down the valley of the Trinity, on the east side, to Bolivar Point on Galveston Bay. The principal towns on this line are Kaufman, Athens, Palestine, Crockett, Sumpter and Livingston. This is a fine country throughout, well timbered, watered and settled. The length of this branch is about 375 miles. The Southwestern Branch is a great road in itself, about 700 miles long to its terminus at Camargo on the Rio Grande. The principal towns from north to south are Waxahatchie, Hillsborough, Waco, Belton, Georgestown, Austin, (the capital) San Marcos, Braunfels, San Antonio, Camargo. It lies through a fine country to Austin, and from there to San Antonio, perhaps the most beautiful region on the continent. This section, particularly the San Marcos and Guadaloupe valleys, is universally admired, and may be called the Italy of North America. From San Antonio it traverses the great stock region of Southern Texas in its whole length, and on its lower end, the great deposits of crystalized salt."

Burlington & Missouri River.

The annual meeting was held at Burlington, Iowa, on the 21st of June. Without the transaction of any other business, it was resolved to adjourn to the 19th of July.

New Mail Routes.

The Postmaster-General ordered mail service to be performed by the Pittsburgh & Connellsville Railroad Company, beginning July 1, from Pittsburgh to Cumberland, 147 miles, and back, serving all way offices six times a week, or oftener if required, with a branch from Broad Ford to Mount Pleasant and from Connellsville to Uniontown, in close connection with service on the main line.

An order has been issued, establishing mail service, from July 1, on the St Paul & Chicago Railroad, between St. Paul and Red Wing, Minn., 51½ miles, six times a week, or as much oftener as trains may run.

Ohio & Mississippi.

The change of gauge from 6 feet to 4 feet 8½ inches is to be made on the North Vernon & Jeffersonville Branch of this road, on Sunday, the 16th inst., and on the main line on the next Sunday.

Rockford Central.

The line between Rockford and Rockton has been "conditionally" located, passing up the west bank of Rock River, through Owen and crossing the river at Rockton. The condition is that Rockford and Owen raise an additional $25,000, and the machine shops are to be located at Rockford.

During last week propositions for a consolidation were received from the Madison, Portage & Grand Rapids and the Madison & Sugar Valley companies, the consolidated company to be called the "Chicago & Duluth Railroad Company."

The Hannibal Bridge.

The tunnel approach to the west end of this bridge over the Mississippi is over six hundred feet long. On Tuesday evening, of this week, a "hole" was pierced through. The bridge will be ready for the formal "opening" some time between the 15th and 20th of this month, probably.

"National Freight Transfer Improvement."

We have some information of an improvement with the above title, which is, we judge, to be applied to the trucks, and is said to be applicable to freight as well as passenger cars, adapting them to the 5 feet or 4 feet 8½ inch guage, or to narrower gauges, should such breaks exist. Mr. Geo. French, the patentee, is organizing a company at Alexandria, Virginia.

Evansville, Terre Haute & Chicago.

This road, which, when completed, will extend from Terre Haute, Ind., to Danville, Ill., connecting the Chicago, Danville & Vincennes road with the Evansville & Crawfordsville, is now in operation from Terre Haute northward to Perryville, within about ten miles

of Danville. The stations on the line are: Terre Haute, Numa, Gravel Bank, Clinton, Helt's Prairie, Montezuma, Highland, Newport, Eugene, and Perrysville.

Cairo & St. Louis.

The St. Louis *Republican* of the 20th says: "The Cairo & St. Louis Railroad bids fair to be speedily completed. Engineers, with their instruments, have been out on the route for the past two weeks. The road will run from East St. Louis to Waterloo, in Monroe County, Ill.; Red Bud and Sparta, in Randolph County; Murphysboro, in Jackson County; Jonesboro, in Union County, and thence to Cairo. The route is very direct, and will be 30 miles shorter than any other railway from Cairo to St. Louis. In Jackson County it will run a distance of 18 miles through the Muddy coal-fields. This coal is said to be equal in every respect to the Pittsburgh coal, and is used in all the iron furnaces of this city. There will be some heavy grading between Murphysboro and Jonesboro, but the engineers, after a thorough examination, have found a feasible route. All the rest of the distance is easy grading, and the line passes through the finest portion of Southern Illinois."

The route which the *Republican* describes is by no means a direct one, but is quite 130 miles long, which is only 18 miles shorter than the route by Belleville and Du Quoin. It is also unprofitably near to that route, being at only one or two points more than ten miles, most of the way from ten to six miles, and for one-fourth of the distance, from Jonesboro to Cairo, much closer to it. It is, however, perhaps the most eligible route that can be had on the uplands west of the Illinois Central, and a line near the Mississippi would probably be costly and liable to interruption by floods.

Long Island Railroad.

Oliver Charlick, President of the Long Island Railroad, was entertained at a banquet last week, by citizens of Riverhead, L. I. Mr. Charlick made a speech, saying he would soon make the Long Island road the direct route to the Eastern States from New York.

The New Jersey Lease.

Chancellor Zabreskie, of New Jersey, granted a temporary injunction, on which he will hear argument, July 25, to show why it should not be made perpetual, restraining the proposed lease and transfer of the property and franchise of the United Railroad Companies of New Jersey to the Pennsylvania Railroad Company. The grounds on which the injunction is asked are that the act authorizing the lease is unconstitutional; that the Pennsylvania road is not a connected and continuous road, which the act re uires, and that by no act of the Legislature can persons who own property be compelled to part with it without giving their full consent and receiving full compensation.

Owensboro & Russellville.

This railroad is in operation from Owensboro, Ky., on the Ohio River about 30 miles southeast of Evansville, southward to Livermore, on Green River, a distance of 20 miles. Fifteen miles more, from Livermore up Green River to a point on the Elizabethtown & Paducah Railroad, is under contract.

Mineral Range & L'Anse Bay.

The original subscribers to the scheme for building a narrow-gauge railroad from L'Anse Bay to the boundary line between Houghton and Keweenaw counties, Mich., met in Hancock a few days ago, and organized a company, with a capital of $200,000, under the revised laws of the State of Michigan, to be known as the "Mineral Range & L'Anse Bay Railroad." It is the intention of the company to take immediate steps toward building a section of the road, from the north side of Portage Lake to the boundary line.

Mexico & Monroe City.

The directors are about to have a survey made for their line from Mexico, on the North Missouri road, northward to Monroe, on the Hannibal & St. Joseph, a distance of about 32 miles. The amount of capital stock has been fixed at $600,000, and books for stock subscriptions are to be opened at St. Louis, Chicago, Hannibal, Mexico and Monroe City.

Port Royal Railroad.

This railroad is to extend from Port Royal, S. C., northwestward to Augusta, Ga., 110 miles. Twenty-nine miles is in operation and 51 more nearly completed. The road is expected to create a considerable seaport town at Beaufort, as it will connect it with the system of railroads having a terminus at Augusta.

Panama Railroad.

Information from Panama dated the 23d ult., announces that the railroad directors have notified the government that they will refuse to pay annually, hereafter, the $250,000, and offer, instead, to allow the government a certain proportion of the profits.

Dunkirk, Warren & Pittsburgh.

Track has been laid on several miles of this road from Dunkirk southward through Fredonia, and it is believed that it will be completed to Warren, Pa., 54 miles, before September. At Warren it will connect with the Philadelphia & Erie and Warren & Franklin roads.

Cincinnati, Wabash & Michigan.

The Warsaw, Goshen & White Pigeon Railroad Company and the Grand Rapids, Wabash & Cincinnati Railroad have been consolidated under the name and title of the Cincinnati, Wabash & Michigan Railroad Company. The line of road of the consolidated company extends from Anderson, Ind., nearly due north to the Michigan State line, passing through Marion, Wabash and Goshen. The road is completed from Goshen to Warsaw, and is being rapidly extended to Wabash. The officers of the company are: Ransom Gardner, President; C. Cowgill, Vice-President; E. W. H. Ellis, Secretary; A. G. Wells, Superintendent. The total length of the line is 120 miles.

At Anderson the Bellefontaine road will connect it with Indianapolis, and the Columbus, Chicago & Indiana Central with Cincinnati.

Chicago & Rock River.

It is now reported that an agreement has been made to construct this road, from Rock Falls (opposite Sterling), through Amboy, to a connection with the Chicago & Iowa road at Cornton Station, in the town of Shabbona, DeKalb County, a distance of about 40 miles. This will not vary much from the original line, but that it was intended to continue eastward through or near Sandwich, Plano, Bristol and Plainfield to Lockport.

Macon & Western.

In Macon, Ga., on the 23d inst., Judge Alexander gave a decision sustaining the injunction and affirming the right of this company to lease its road, but doubting the right of the Central of Georgia to become the lessee.

Pittsburgh & Connellsville.

The formal opening of this road was celebrated on the 26th inst., by an excursion from Baltimore to Pittsburgh.

Cleveland & Pittsburgh.

The telegraph reports that at a recent meeting of the directors of this company it was resolved that no legal power exists, under the charter of the company or laws of Ohio, by which the increase of fifty per cent. desired by the stockholders can be made, and that the Treasurer be directed to give such notice to the stockholders.

Holly, Wayne & Monroe.

This road, which is to form the southern division of the Flint & Pere Marquette Railroad, is progressing favorably, and is to be completed by November. The Flint & Pere Marquette Company is already constructing rolling stock for it. A contract has been made for the use of the Michigan Southern's track between Monroe and Toledo, and it is probable that trains will all run through to Toledo.

Chicago & Canada Southern.

Articles of consolidation between the Michigan Air Line Railroad Company, of Illinois, and the Chicago & Canada Southern Railroad Company, of Indiana, under the style and name of the Chicago & Canada Southern Railway Company, capital stock $1,500,000, were filed in the office of the Secretary of State of Illinois, at Springfield, June 27. Thus the Chicago & Canada Southern secures the charter for a line in Illinois which the Michigan Air Line, having been merged with other corporations, no longer wants.

Milwaukee, Chicago, Cassville & Montana.

The Des Moines (Iowa) *Register* of the the 25th says: "On Thursday last, articles of incorporation were filed of the Milwaukee, Chicago, Cassville & Montana Railroad Company. This road is to run from Milwaukee, Wis., and Chicago, by the most feasible and direct route to Helena, Montana Territory. The capital is $60,000,000, in shares of $100 each; and the company are at no time to allow the aggregate indebtedness to exceed $40,000,000. The incorporators are: Elias H. Williams, J. A. Hysham, Thomas Updegraff, James O. Crosby and H. B. Carter; and the provisional Board of Directors, who are to hold office until the first Monday in June, 1872, are: Henry B. Carter, James O. Crosby, Elias H. Williams, Nelson Dewey and Thomas Updegraff. The principal place of business is to be at the city of McGregor, Iowa.

Memphis & Selma.

This railroad, of which Gen. N. B. Forrest is the President, has been mortgaged to Porter King, of Marion, Ala.; Abram S. Humphreys, of Columbus, Miss., and Ira M. Hill, of Memphis, for $4,250,000, to secure the first mortgage bonds. Several miles of the road are completed and a large part graded.

Chester & Tamaroa.

From an officer of the company we learn that this road is completed and in operation from Tamaroa, on the Illinois Central Railroad, 85 miles north of Cairo, southwest to Pinckneyville, on the Belleville & Southern Illinois Railroad about ten miles; that the whole road thence to Chester, about 28 miles, is under contract with from 500 to 1,000 men at work on it, and that it is hoped to have it completed by the last of October, or earlier.

This line, less than 40 miles long, will run from Tamaroa for about 25 miles, pass through the coal fields of Perry and Randolph counties, part of that in Randolph County being known as block coal, and recommended as unusually well fitted for iron smelting. It is believed that an immense demand for this coal may be had on the Mississippi, from which the nearest mines are only 15 miles distant, as navigation south of Chester is never interrupted by low water as it is for a large part of the summer on the Ohio. Moreover, the ores of the Iron Mountain district are only fifty miles from Chester, and will probably soon be accessible by a railroad from St. Genevieve, a few miles above that place. The country on the line of this road is also famous for the production of a fine quality of winter wheat. The towns and counties on the line have subscribed $315,000 in their bonds in aid of the road, and the company is authorized to issue $16,500 in first-mortgage bonds bearing 7 per cent. gold interest.

California Pacific Eastern Extension.

It is reported that contracts have been let for the construction of this road from Davisville, 14 miles west of Sacramento, to Shasta, 145 miles. This cannot reasonably be called an "Eastern Extension," for its direction is actually west of north, Shasta being about 18 miles further west than Davisville. But it is not easy to see why this extension should be described as beginning at Davisville; Davisville, or "Davis," as it is called on the time-table of the California Pacific, is the point of Junction of a branch of the Vallejo & Sacramento line of the California Pacific, which extends thence directly towards Shasta to Marysville, 42 miles. From Marysville directly to Shasta the route is near the Sacramento and about 100 miles long. But this route the Central Pacific has already occupied, and its road, the California & Oregon, is completed to a point within 40 miles of Shasta. If the California Pacific should choose a more easterly route, it will find ready at hand 26 miles of railroad from Marysville east of north up the Feather River to Oroville, owned by the Northern California Railroad Company. Beginning at Oroville it would have little more than 80 miles of road to construct in order to reach Shasta. A route is practicable, however, entirely west of the Sacramento River, and between it and the Coast Range, from Davisville to Shasta.

Lawrence & Pleasant Hill.

The Lawrence (Kan.) *Tribune* of the 17th says: "Mr. Hall, the contractor, has finished work on the Lexington, Lake & Gulf Railroad, running from Lexington to Butler, Mo., and the force heretofore employed on that road will be placed, next Monday, on the Pleasant Hill road. An extension of forty days was given to Mr. Hall wherein to finish his work. But a small portion of this extension of time will be needed. There are but twelve miles more of grading to be done, which, together with the finishing up of the bridges and heavy culverts, will all be done by the 15th of July. The work between this point and Eudora, and beyond, is now about finished."

International Railway.

The Engineer, Mr. Ramsay, and his assistants, are now exploring the route from Bury to Lake Megantic and the Boundary Line. We understand the directors have decided to adopt the route recently surveyed from Lennoxville to Bury, by way of Johnville, Birchton, and "Slab City"—distance about 27 miles. The Grand Trunk Railway Company having removed (or decided to remove) their machine and engine repair works to Richmond, it is said that the large engine-house and the brick repair shop have been offered to the Passumpsic Railroad Company, and that the Massawippi Railway will be extended to Sherbrooke by means of a third rail on the Grand Trunk track, and that in the arrangements to be made between the two companies, the same right or privileges will be granted or reserved to the International Road.—*Sherbrooke Gazette.*

Indianapolis, Cincinnati & Lafayette.

A motion to force this company into bankruptcy is to be held by Judge Gresham, at New Albany, Ind., on the 6th inst. The following legal gentlemen are concerned in the case: Harry Crawford, Chicago; Stanley Matthews, George E. Pugh and Judge Hoadley, Cincinnati; Hendricks, Hurd & Hendricks; Porter, Harrison & Hines, and McDonald, Butler & McDonald, of Indianapolis.

Springfield & Illinois Southeastern.

The Springfield *Register* says that this company contemplates an extension northwestward from Beardstown to Keokuk.

TRAFFIC AND EARNINGS.

—The traffic receipts of the Grand Trunk of Canada for the week ending June 3 amounted to £29,900, against £30,200 in the corresponding week of last year, showing an decrease of £300.

—The receipts of the Great Western Railway, of Canada, were for the week ending,

	May 26.	*June* 2.
Passengers	$31,265 12	$29,562 86
Freight and live stock	47,281 26	48,512 26
Mails and sundries	2,521 68	2,375 97
Total Receipts for week	$81,068 06	$80,451 09
Corresponding week, 1870	77,656 59	77,322 54
Increase	$ 3,411 47	$ 3,128 55

—The Lake Superior trade has largely increased of late, chiefly the result of the construction of the Lake Superior & Mississippi and the Northern Pacific railroads, the former of which now gives a considerable freight eastward, while the latter loads vessel after vessel with material for construction to be conveyed westward. Three years ago there was but one regular line of steamers to Lake Superior, the Detroit & Cleveland line, and one Canadian steamer. Now there is a line from Chicago and Milwaukee to Duluth, one from Ogdensburg, two from Buffalo, and four Canadian steamers in the trade.

—A letter from a San Francisco merchant to the *American Grocer* gives the following particulars of the time and cost of shipping teas from Yokohama and Hong Kong to Chicago: "Shipments of tea by steamers of the Pacific Mail Steamship Company from Hong Kong and Shanghai arrived here in about thirty days, and those from Yokohama, Japan, in twenty-two days. The rate of freight from Shanghai and Yokohama is one and three-fourths cents per pound gross weight, while from Hong Kong it is somewhat lower. Upon arrival here the teas can be placed in store without the expense of cartage, as a fine United States bonded warehouse stands beside the wharf of the Pacific Mail Steamship Company. The rails of the Central Pacific Railroad run by the doors of this warehouse to the wharf of the Pacific Mail Steamship Company, so that the teas can be either shipped by rail directly from the steamer or else be stored for future distribution over the continent. The charge for storing and delivering for the first month is $1 gold per ton, and 62½ cents gold for each additional month. The rate of freight to Chicago *via* Pacific Railroad is 3¼ cents currency per gross pound, and this rate would not vary much to other points. Cars loaded from the steamer or warehouse go through direct to place of destination."

—The railway from Schweinfurt to Kissingen, celebrated for the medicinal properties of its thermal waters, was opened on the 15th of June.